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Analysis and evaluation of the Department of Defense's shift from motor carrier to rail movements of ammunition within the Continental United States

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THESIS

ANALYSIS AND EVALUATION OF THE DEPARTMENT OF DEFENSE'S SHIFT FROM MOTOR CARRIER TO RAIL MOVEMENTS OF AMMUNITION WITHIN THE CONTINENTAL UNITED STATES

by

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The Department of Defense relied heavily on commercial transportation for both unit deployment and ammunition sustainment during Desert Shield/Desert Storm. Nearly 70 percent of all ammunition was carried by commercial truck companies. The Mobility Requirements Study (MRS) and Mobility Requirements Study Bottom Up Review Update (MRS BURU) identified transportation requirements for mobilization in response to a Major Regional Contingency (MRC). There are many issues and concerns within both industry and DoD that can be identified as factors affecting readiness, such as declining numbers and sizes of railcars and insufficient Container Handling Equipment at ammunition depots. These factors and others risk DoD's ability to deploy ammunition rapidly in response to contingencies and conduct efficient day-to-day operations. Many of these factors stem from the way DoD does business, the changing industry environment, and inconsistent peacetime versus wartime operational requirements. This thesis analyzes factors affecting modal combination decisions as well as the current and future viability for transporting DoD's arms, ammunition, and explosives.

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ABSTRACT

The Department of Defense relied heavily on commercial transportation for both unit deployment and ammunition sustainment during Desert Shield/Desert Storm. Nearly 70 percent of all ammunition was carried by commercial truck companies.

The Mobility Requirements Study (MRS) and Mobility Requirements Study Bottom Up Review Update (MRS BURU) identified transportation requirements for mobilization in response to a Major Regional Contingency (MRC). There are many issues and concerns within both industry and DoD that can be identified as factors affecting readiness, such as declining numbers and sizes of railcars and insufficient Container Handling Equipment at ammunition depots. These factors and others risk DoD's ability to deploy ammunition rapidly in response to contingencies and conduct efficient day-to-day operations. Many of these factors stem from the way DoD does business, the changing industry environment, and inconsistent peacetime versus wartime operational requirements.

This thesis analyzes factors affecting modal combination decisions as well as the current and future viability for transporting DoD's arms, ammunition, and explosives.

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I. INTRODUCTION

A. PURPOSE

This thesis analyzes current commercial transportation capabilities and applies them to the Department of Defense's (DoD) requirements for moving conventional ammunition from depot to port within the Continental United States (CONUS) during peacetime and mobilization. Conventional ammunition is defined as "a device charged with explosives, propellants, pyrotechnics, or initiating composition for use in connection with defense or offense, including demolitions" [Ref. 1:p. 6]. There are two general ammunition categories. Conventional ammunition inventory is distinguished as being either wholesale or retail. Wholesale inventory is all conventional ammunition stocks between the point of production and the point of receipt at the first intermediate (retail) Continental United States (CONUS) activity. Retail inventory is all conventional ammunition stocks between the point of receipt at the first intermediate (retail) CONUS activity and the point of consumption. [Ref. 2:p. 14-1-15]

The research will consider security, equipment capabilities, limitations, availability, and industry trends for the movement of wholesale and retail conventional ammunition by commercial rail and motor carriers. The objective of this thesis is to determine the most efficient modal combination, as well as the current and future viability for transporting arms, ammunition, and explosives for the DoD.

B. BACKGROUND

The DoD relied heavily on commercial transportation for both unit deployment and ammunition sustainment during Desert Shield/Desert Storm. Approximately 16,000 commercial railcars and 54,000 commercial trucks were used to transport 1.2 million tons of unit cargo to U.S. seaports. Nearly 70 percent of all ammunition was carried by commercial truck companies. Overall, the commercial sector carried nearly 90 percent of the tonnage transported by truck and rail to U.S. ports. [Ref. 3]

The Mobility Requirements Study (MRS) and Mobility Requirements Study Bottom Up Review Update (MRS BURU) identified transportation requirements for mobilization in response to a Major Regional Contingency (MRC). Currently DoD ammunition is transported 90% by motor carrier (truck) and 10% by rail [Ref. 4]. DoD's goal is to increasingly containerize its ammunition and change the transportation ratio to 90% rail and 10% truck [Ref. 5].

There are many issues and concerns within both industry and DoD that can be identified as factors affecting readiness. These factors risk DoD's ability to deploy ammunition rapidly in response to contingencies and conduct efficient day-to-day operations. Many of these factors stem from the way DoD does business, the changing industry environment, and inconsistent peacetime versus wartime operational requirements. There has not been an independent assessment of current or projected commercial transportation capabilities that would affect this policy shift.

C. RESEARCH QUESTIONS

1. Primary Research Question:

Given the current process of Department of Defense ammunition shipment in both peacetime and/or mobilization, what is the most efficient modal method to transport munitions?

2. Secondary Research Questions:

- What is the current process for moving ammunition from depot to port?
- What is the Department of Defense ammunition organization?
- How does DoD acquire ammunition?
- How is ammunition documented?
- What is the Department of Defense's proposed ammunition delivery policy shift?
- What is the basis for the policy shift?
- What security requirements exist for ammunition shipments?
- What is breakbulk cargo?
- What is containerized cargo?
- What are commercial rails' capabilities in terms of security, equipment limitations, equipment availability, and access?
- What are commercial motor carriers' capabilities in terms of security, equipment limitations, equipment availability, and access?
- What types of containers are used for ammunition transportation?
- What is the current ratio of truck to rail shipments?
- How would transportation requirements for ammunition change during mobilization for a MRC?

D. SCOPE OF THESIS

This thesis will focus on DoD certified munitions carriers to assess their current and future capability to support ammunition shipment. To understand the current and future shipment requirements, historical shipment data will be obtained for the Department of Defense as a whole, and specifically from each of the Tier I and II Army

ammunition depots to the three DoD ammunition ports. Tier I and II Army ammunition depots include: Anniston, Alabama; Bluegrass, Kentucky; Crane, Indiana; Hawthorne, Nevada; Letterkenny, Pennsylvania; McAlester, Oklahoma; Red River, Texas; and Tooele, Utah. Department of Defense ammunition ports include: Naval Weapons Station Seal Beach, Detachment Port Hadlock, Washington; Naval Weapons Station Seal Beach, Detachment Concord, California; and Military Ocean Terminal, Sunny Point, North Carolina.

E. METHODOLOGY

To better understand ammunition transportation and the related requirements and issues, this research first provides a general overview of the ammunition supply chain, the organizations involved, and the requirements for transportation during peacetime and mobilization. In order to accomplish this the following resources were utilized:

- Department of Defense Publications
- Books, Periodicals, Journals and electronic resources available at the Naval Postgraduate School (NPS) Library
- Internet web-sites pertaining to the organizations involved in ammunition management

Then, the equipment required for shipping ammunition is analyzed, emphasizing the industry trends and potential impact on the ammunition supply chain. In addition to the resources listed above, information was obtained from exercise lessons learned and studies conducted by DoD agencies involved in ammunition management. Also, government personnel with key roles in the ammunition transportation process were interviewed. The commercial trucking companies who transport arms, ammunition, and

explosives were analyzed to gain insight into the ammunition shipping environment. This was accomplished by surveying each company. These analyses provide recommendations about DoD using commercial transportation assets to ship arms, ammunition, and explosives.

F. ORGANIZATION

Chapter II describes the Department of Defense's ammunition supply chain. This includes transportation asset requirements to support mobilization for a Major Regional Contingency. It also provides an overview of exercises and wargames developed to test the ability of DoD and the commercial transportation industry to respond to a MRC.

Chapter III presents the types of equipment utilized for ammunition shipment. It also discusses transportation industry trends that have the potential of affecting future equipment availability. The focus of the chapter is to identify important factors to consider when making transportation mode decisions.

Chapter IV presents the results of a survey of trucking companies involved in shipping ammunition. It describes the survey instrument and survey findings, and discusses the issues affecting motor carriers.

Chapter V provides conclusions about mmunition transportation environment, as well as recommendations for determining future modal decisions and potential areas of further research.

G. BENEFITS OF STUDY

This research provides insight into the complexity of the changing ammunition transportation industry. It will benefit personnel capable of making and changing ammunition transportation policies by exposing trends within the industry that require further attention. It will also benefit individuals making transportation mode decisions on a day-to-day basis by showing how to apply modal characteristics to obtain transportation assets with the best value to the government.

II. AMMUNITION SUPPLY CHAIN MANAGEMENT

The Department of Defense's management of conventional ammunition is a complex system that contains unique characteristics and terminology. This chapter consists of four sections. The first section explains DoD's ammunition management organization. The second section identifies DoD authorized ammunition carriers and presents the current controls and limitations to minimize theft opportunities and maximize safety of ammunition during transportation within CONUS. It also introduces the differences between break-bulk and containerized cargo, and its applicability to ammunition transportation. The third section identifies munitions movement requirements for peacetime and mobilization for a Major Regional Contingency (MRC). The fourth section presents DoD exercises designed to test ordnance transportation capabilities within the DoD and the commercial transportation industry.

A. DEPARTMENT OF DEFENSE AMMUNITION MANAGEMENT ORGANIZATION

Managing the vast quantities of conventional ammunition that DoD produces, stores, and uses is a difficult and complex task. A central organization was created to ease the management burden on each individual service. The core of the management organization is the Single Manager for Conventional Ammunition (SMCA). Figure 2.1 shows the commands that are part of the SMCA organization and their relationships.

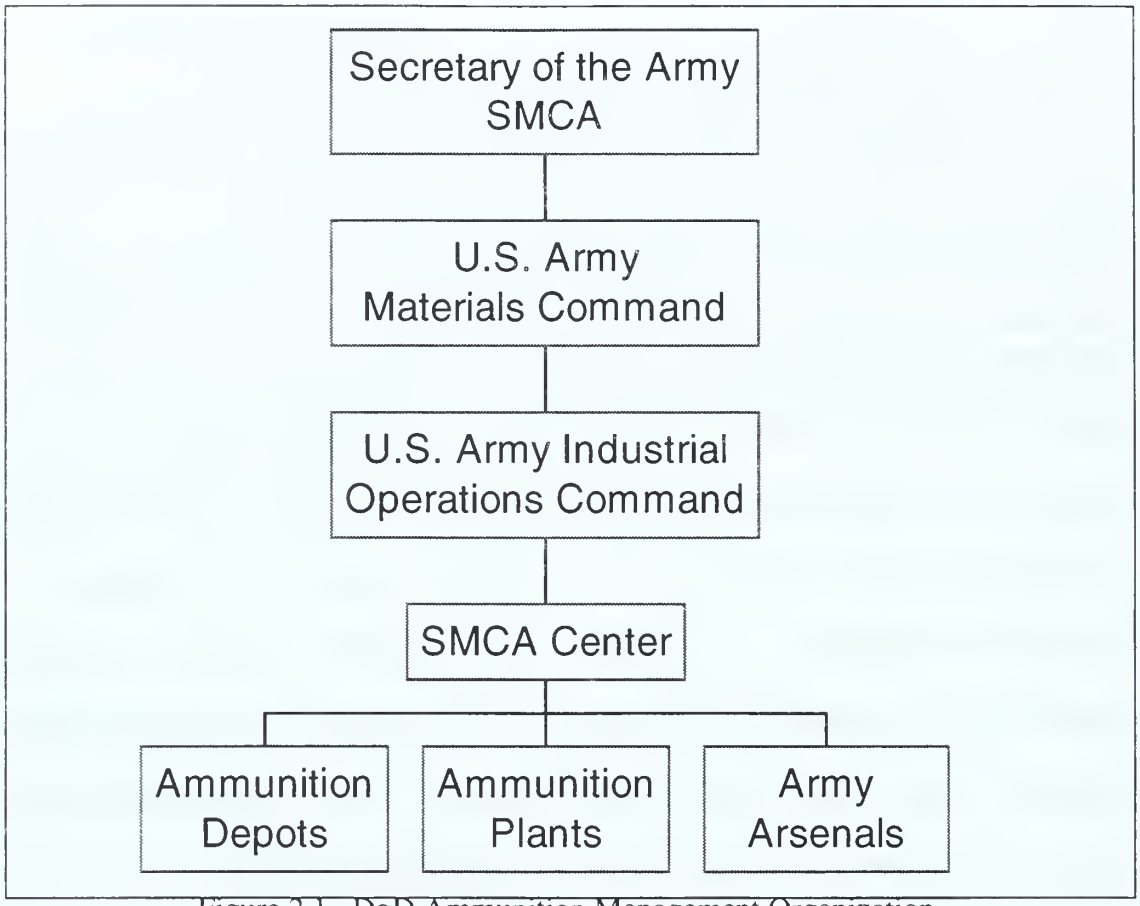

Figure 2.1. DoD Ammunition Management Organization.

1. Secretary of the Army

In 1977, the Department of Defense issued DoD Directive 5160.65, which designated the Army as the Single Manager for Conventional Ammunition (SMCA). This initiative was intended to achieve economies of scale, prevent duplication of efforts among the services, integrate logistics functions, and generally promote efficiency and effectiveness [Ref. 1:p. 2]. Specifically, the Secretary of the Army was assigned the SMCA mission within the DoD with the power to redelegate, within the Army, the necessary authorities to perform the SMCA mission. Authority to execute SMCA operations was delegated to the Army Material Command. [Ref. 6:p. 1-1, 1-2]

2. U. S. Army Material Command

The Army Material Command (AMC), located in Alexandria, Virginia, is responsible for acquiring the ammunition for all the U.S. Military services [Ref. 7:p. 13]. This is accomplished by the Industrial Operations Command (IOC), a subordinate command of AMC.

3. U. S. Army Industrial Operations Command

The Army Industrial Operations Command (IOC), located in Rock Island, Illinois, performs total, worldwide life cycle support of conventional ammunition. Industrial Operations Command's facilities and highly skilled workforce can produce and test new weapon and ammunition products, ship materiel, sustain equipment and support materiel deployed worldwide. They maintain expertise in maintenance, logistics, manufacturing and production. [Ref. 8]

4. SMCA Center

The Single Manager for Conventional Ammunition (SMCA) center, located in IOC headquarters, is responsible for life cycle management of conventional ammunition. It is the National Inventory Control Point (NICP) for munitions and coordinates ammunition procurement for new weapon systems. The SMCA center manages wholesale ammunition, coordinates the production base, and oversees the operations at five arsenals, ten depots, and twenty-two ammunition plants.

Each service determines their own requirements for ammunition based on future year budgets, war plans, and distribution plans. The SMCA center receives input from

the Commander-In-Chiefs (CINCs) and service component commanders to determine amounts of ammunition to be procured and locations to which it will distributed for use or storage. [Ref. 7:p. 50]

The SMCA acts as a wholesaler, providing each service with the desired ammunition and storing it in bulk quantities until distribution to their retail activities. SMCA also provides the storage facilities for wholesale stock. [Ref. 9:p. 21] It provides retail management for the Army. The other services provide retail management through the use of Inventory Control Point (ICP) managers. Although the SMCA center performs wholesale management, each service operates wholesale information systems, which are not linked to each other, to maintain visibility and inventory data on their assets. [Ref. 7:p. 50]

Service Inventory Control Point (ICP) Managers at the retail level receive requisitions from their units for ammunition. If the service ICPs fill the requisition, a source would be identified from their own retail or wholesale stocks. Each service issues from their retail stocks before requesting ammunition from the wholesale level. For ammunition controlled at the wholesale level, each service processes the requisition and releases the ammunition for issue from a designated depot. [Ref. 7:pp. 58-59]

5. U. S. Army Ammunition Depots

After the end of the Cold War, the need for large stockpiles of conventional munitions decreased. The 1993 Mobility Requirements Study (MRS) conducted by the Joint Chiefs of Staff, recommended a smaller, safer, and better quality stockpile of ammunition with a reduced workforce using fewer storage installations. [Ref. 10]

During peacetime, ammunition is consumed primarily for training. A plan was developed to reduce the cost of transporting training ammunition. The plan divided CONUS into eastern, central and western regions for supplying ammunition. Except for the eastern region, each region received one ammunition facility to reduce the cost of transporting training ammunition during peacetime. The eastern region received two facilities because more military bases were located in that region compared to other regions.

The facilities were broken down into different types of "Tiers" based on their function. A Tier I facility stores the first 30 days of war reserve ammunition and ammunition for training. The war reserve ammunition is shipped from Tier I facilities first during a war. Tier II facilities store war reserve ammunition to be used after the first 30 days; Tier III facilities store excess ammunition. [Ref. 7:pp. 15-16] Figure 2.2 shows the name and location of each Tier I and II depot.

6. Ammunition Ports

During peacetime or mobilization, all DoD ammunition is shipped through three ammunition ports. The ammunition ports are located at Port Hadlock, Washington, Concord, California, and Sunny Point, North Carolina. (See Figure 2.2)

The types of vessels these ports can handle depend on the ship's characteristics and the port's infrastructure characteristics. Concord is unable to handle ships higher than 135 feet and with drafts greater than 35 feet [Ref. 11]. Until recently Concord did not have a dedicated container crane. Container throughput was affected by the lack of dedicated container handling equipment. A container gantry crane is scheduled to be

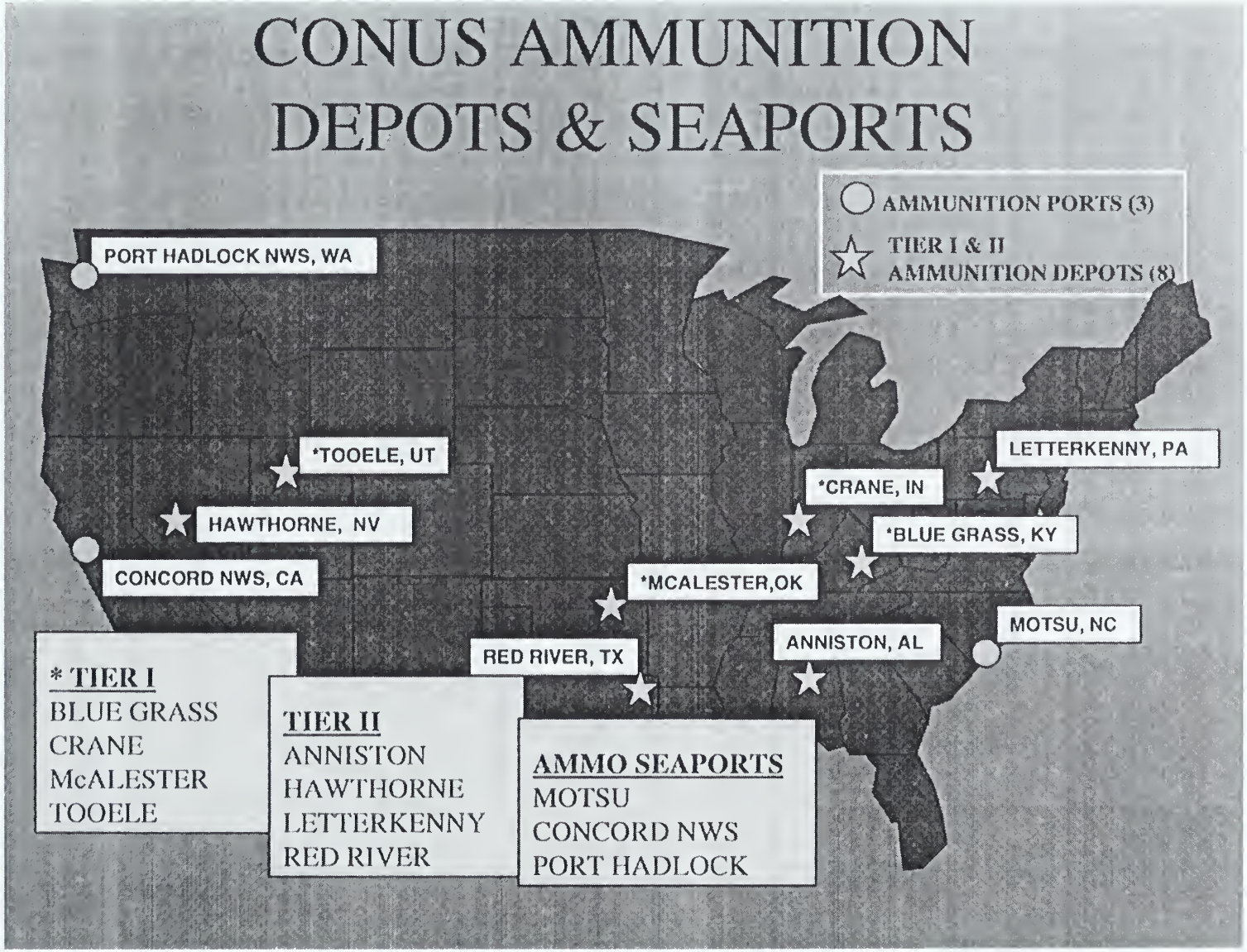

Figure 2.2. Ammunition Depots and Seaports.

delivered to Concord in the spring of 1999 [Ref. 12]. At the Military Ocean Terminal, Sunny Point (MOTSU) access to two of their wharves is limited to ships with drafts under 38 feet. The draft limitation at their remaining wharf is significantly more stringent due to heavy siltation. [Ref. 13] Port Hadlock is capable of handling deep draft vessels but its infrastructure limits throughput. Port Hadlock does not have rail access to the port. The nearest rail facility is a newly constructed intermodal transfer yard at Bangor, Washington. From there, material must be trucked the remaining 40 miles to the port. Also, Port Hadlock is scheduled to receive a new container gantry crane in May, 1999. This will increase container throughput and increase the types of vessels that can be served there. [Ref. 12] Table 2.1 lists specific infrastructure characteristics for each port.

Port	Pier NEW limit (million pounds)	Cranes	Material Handling Equipment	Rail and Truck Equipment
Concord	Pier 2 – 7 Pier 3 – 11.235 Pier 4 – 6	1 floating crane, 7 shore cranes, including one new gantry crane.	1 superstacker, 1 RTCH, 342 forklifts	9 locomotives, 474 railcars
Port Hadlock	Pier 1 – 2.25	5 mobile cranes 1 new gantry crane	39 forklifts, two 25-ton container forklifts, one 35-ton Top Handler	3 tractors, 10 48-foot twist-lock chassis
MOTSU	>50 terminal-wide (three wharves)	2 container cranes	Six RTCH	7 locomotives, 145 boxcars, 40 flatbed railcars, 15 tractors, 800 20-foot chassis

Table 2.1. Ammunition Port Infrastructure Characteristics [Ref. 11, 12, 13].

a. Naval Weapons Station Seal Beach, Detachment Concord

Concord is located on the Suisan Bay of the Sacramento River in California, about 39 nautical miles from the Golden Gate Bridge. Concord is the biggest naval ordnance support operation in the nation. Ship access is limited by a rail bridge crossing the channel. Bridge clearance is 135 feet, with ship draft limited to 35 feet and width of 300 feet. [Ref. 11]

The Inland Area consists of administrative buildings and weapon storage magazines. Concord's primary purpose is loading and unloading large quantities of weapons and equipment from cargo and pre-positioned ships. [Ref. 12]

b. Naval Weapons Station Seal Beach, Detachment Port Hadlock

Port Hadlock is the only ordnance base on the Pacific Coast capable of pierside loading of deep draft, high mast vessels such as aircraft carriers, large amphibious ships, and replenishment ships. [Ref. 12]

c. Military Ocean Terminal, Sunny Point

Military Ocean Terminal, Sunny Point (MOTSU) is located five miles north of Southport, North Carolina on the Cape Fear River. It provides worldwide transshipment of DoD ammunition, explosives, and other dangerous cargo and predominantly serves prepositioned ships. [Ref. 13]

B. AMMUNITION TRANSPORTATION

The Joint Chiefs of Staff stated in the Focused Logistics portion of Joint Vision 2010 that "outsourcing, privatization and competition offer the prospective of lowering

costs and improving performance across a wide range of activities..." [Ref. 14]. Department of Defense policy is to rely on the commercial transportation industry to the extent feasible to meet military shipping requirements [Ref. 5:p. VI-3].

In the early to mid-1980's, concern over the security of in-transit ammunition, explosives and weapons, especially small missiles and other portable munitions, rose with the tide of international terrorism. A Navy report issued in May, 1985 said "naval ordnance shipments are vulnerable to threats of espionage, terrorism and carelessness." "We have become too cavalier" about safeguarding sensitive shipments, the Head of the Naval Sea Systems Command said in a memo several months earlier. An Army inspector general's report in September, 1985 stated that "commercial transportation of ammunition is extremely vulnerable to theft." [Ref. 15]

The discovery of serious flaws in the munitions transportation system stirred concern inside the Pentagon because the particular weapons involved were so directly applicable to terrorism and because shipments move across the country in such great numbers. [Ref. 15]

Highly secret shipments of nuclear weapons use professionally trained guards and drivers, as well as specially built government trucks equipped with elaborate communications gear to keep track of the cargo. Such precautions are considered prohibitively expensive for the 45,000-50,000 per year shipments of all types of conventional military munitions. The Pentagon also feels compelled to use commercial trucking firms because, one official said, the law prohibits government competition with private-sector transportation [Ref. 15]. According to a Defense Department official,

Pentagon procedures for shipping conventional munitions are deliberately intended to "keep a low profile," apparently in the hope that such shipments will be virtually indistinguishable from other civilian cargoes on the nation's highways. He stated, "It would be counterproductive to have everything move in military convoys." [Ref. 15] While the DoD continues to be dedicated to the use of commercial transportation, the perceived poor security performance and high risk did instigate reassessing and redefining security requirements for ammunition shipments.

Peculiarities associated with ammunition separate it from other commodities managed by the Department of Defense. The most obvious is the inherent danger associated with handling explosives. To assist the logistics community in storing, shipping, and handling ammunition, specific items are divided into explosive classes, which denote compatibility with other end items based on volatility and hazards of progressive combustion. [Ref. 9:p. 12] Additionally, Net Explosive Weight (NEW) limitations are placed on all facilities and ports that handle ammunition to minimize the amount of damage caused by an explosion. The DoD bases its ammunition transportation security requirements on the risk to others if it should be stolen. The ammunition classifications that DoD currently uses are hazard classification, security risk categories and codes, and Net Explosive Weight (NEW).

1. Hazard Classification

DoD's hazard classification system reflects the United Nations Organization's (UNO) nine classes for dangerous goods. The nine classes are:

- Class 1 for ammunition and explosives.
- Class 2 for gases, flammable or nonflammable.
- Class 3 for flammable liquids.
- Class 4 for flammable solids or substances, including spontaneous combustible and flammable when wet.
- Class 5 for oxidizing substances.
- Class 6 for poisonous and infectious substances, liquids and solids (includes ammunition which contain toxic chemical agents, and containers of toxic chemical agents in bulk).
- Class 7 for radioactive substances.
- Class 8 for corrosives.
- Class 9 for miscellaneous dangerous substances. [Ref. 16:pp. 1-17—1-18]

Within Hazard Class 1, ammunition and explosives are further broken down into divisions, which indicate the hazard based on the "...character and predominance of associated hazards and on the potential for causing personnel casualties or property damage." [Ref. 17] DoD Class 1 materials are listed by their division designators in Table 2.2.

Division Designator	Description
1.1	Mass detonating
1.2	Non-mass detonating, projection hazard
1.3	Mass fire, minor blast or projection hazard
1.4	Moderate fire hazard, no blast
1.5	Very insensitive substances

Table 2.2. Hazard Class 1 (Ammunition & Explosives) [Ref. 17:pp. 1-17—1-18].

2. Security Risk Categories and Codes

On the basis of their relative utility, attractiveness, and availability to criminal elements, sensitive Arms, Ammunition, and Explosives (AA&E) are categorized

according to the risks involved. A munition's Security Risk Category is determined by assessing its potential utility, casualty and/or damage effect, adaptability, and portability. Security Risk Categories are the classification codes the military uses when defining security requirements for an ammunition shipment. Ammunition is further divided into 12 Security Risk Codes (SRCs) based on whether the item is confidential, secret, or unclassified. [Ref. 18] Table 2.3 lists the Security Risk Categories and applicable types of ammunition associated with each.

Security Risk Category	Description
CAT I	Manportable missiles and rockets in a ready-to-fire configuration (e.g., Redeye, Stinger, LAW, etc.) and the explosive rounds for them.
CAT II	HE or WP hand or rifle fired grenades, explosives for demolition operations, and light automatic weapons up to and including .50 caliber and 40mm machine guns.
CAT III	Explosive filled projectiles .50 caliber and larger, weighing 100 pounds or less, blasting caps, and bulk explosives.
CAT IV	Non-explosive projectiles weighing 100 pounds or less, riot control agents, handguns, and materials not included under Categories I through III above.

Table 2.3. Security Risk Categories [Ref. 18:pp. A-1—A-2].

3. Net Explosive Weight

All ammunition storage and processing facilities have Net Explosive Weight (NEW) limits specifying the maximum NEW which can be present. Limits are placed on truck and rail loading, unloading, and storage areas. Limits are placed on piers where ammunition is loaded and unloaded, which includes the ships being loaded or unloaded. The NEW for a given list of ammunition is the sum of what are known as the Net Equivalent Explosive Weights for the individual ammunition items. The net weight of

explosives for given ammunition items are listed in Tables in both NAVSEA OP-5 and NAVSEA OP-2165. NEW computations depend on whether the material is at a shore facility, aboard ship, or aboard cargo ships. For each of these, there are specific rules for assigning net weights of explosives and the types of NEW there. [Ref. 19]

4. Department of Transportation Classification

The explosive classification system to which commercial transportation providers are subject is delineated in the Code of Federal Regulations. The Department of Transportation developed a classification code that incorporates the United Nations hazard classification system and a compatibility group designation. Compatibility group letters are used to control transporting and storing explosives and to prevent an increase in hazard that might result if certain types of explosives were stored or transported together. The classification code for an explosive consists of the UN division number followed by the compatibility group letter. [Ref. 20:pp. 415 – 416] Specific classification codes are listed in Table 2.4.

5. Transportation Protective Services

The degree of security required for shipping sensitive material varies from one shipment to the next. Transportation Protective Services (TPS) are commercial carrier services performed to DoD standards that provide physical security while transporting AA&E. Each level of security is based on the category of material being shipped. Minimum security requirements for conventional ammunition shipments are listed in Appendix A and defined below. [Ref. 18:p. x]

Description of substances or article to be classified	Compatibility group	Classification code
Primary explosive substance	A	1.1A
Article containing a primary explosive substance and not containing two or more effective Protective features.	B	1.1B 1.2B 1.4B
Propellant explosive substance or other Deflagrating explosive substance or article Containing such explosive substance.	C	1.1C 1.2C 1.3C 1.4C
Secondary detonating explosive substance or Black powder or article containing a secondary Detonating explosive substance without means of initiation.	D	1.1D 1.2D 1.4D 1.5D
Article containing a secondary detonating Explosive substance, without a means of Initiation, with a propelling charge	E	1.1E 1.2E 1.4E
Article containing a secondary detonating Explosive substance with its means of Initiation, with a propelling charge, or without a Propelling charge.	F	1.1F 1.2F 1.3F 1.4F
Pyrotechnic substance or article containing a pyrotechnic substance, or article containing Both an explosive substance and an illuminating, Incendiary, tear- or smoke-producing substance.	G	1.1G 1.2G 1.3G 1.4G
Article containing both an explosive substance And white phosphorus.	H	1.2H 1.3H
Article containing both an explosive substance And flammable liquid or gel.	J	1.1J 1.2J 1.3J
Article containing both an explosive substance And a toxic chemical agent.	K	1.2K 1.3K
Explosive substance or article containing an Explosive substance and presenting a special Risk needing isolation of each type.	L	1.1L 1.2L 1.3L
Articles containing only extremely insensitive Detonating substances.	N	1.6N

Table 2.4. Department of Transportation Classification Codes [Ref. 23: pp. 415-416].

a. Satellite Motor Surveillance Service (SM)

Satellite Motor Surveillance Service (SM) is a TPS that provides the Defense Transportation Tracking System (DTTS) with hourly, accurate truck location reports, two-way communication for reporting in-transit truck status changes, and emergency situation notification.

b. Dual Driver Protective Service (DD)

Dual Driver Protective Service (DD) is a TPS for Categories III and IV AA&E that requires a commercial carrier to use two drivers in each vehicle to maintain constant surveillance.

c. Dual Driver Protective Service with National Agency Check (DN)

Dual Driver (DD) Protective Service with a National Agency Check (DN) is a TPS for Categories I and II AA&E. It requires a commercial carrier to use two drivers who have received favorable National Agency Checks. A National Agency Check is a background investigation by an agency such as the Federal Bureau of Investigation. The check ensures the individual does not have a history of drug use or criminal activity.

d. Rail Armed Guard Surveillance Service (RG)

Rail Armed Guard Surveillance Service (RG) is a TPS that provides one armed guard to maintain constant and specific 24-hour surveillance on specified rail cars. As an alternative, guard(s) may escort the rail movement in a separate motor vehicle, providing surveillance is maintained.

e. Military Traffic Expediting Service (MTX)

The Association of American Railroads (AAR) provides this service through its automated communications service network with member railroads. The AAR is linked to all railroads transporting DoD shipments through the TRAIN II automated tracking system. The purpose of MTX is to keep Military Traffic Management Command (MTMC) informed of the status and location of rail cars during movement from origin to destination. This expediting service is available for single and joint line movements and is required for sensitive shipments from origin to destination.

f. Rail Inspection Service (RI)

Rail Inspection Service is in-transit inspection, performed by rail carriers of sensitive and pilferable items. Rail Inspection Service includes MTX service. Inspection under RI is external only. It assures the integrity of the shipment container or vehicle and the seals and locking devices securing them. [Ref. 18:pp. x – xiii]

The DoD realized the necessity of providing definitive security provisions for ammunition shipments. Using government transportation and guard assets was not an option because of prohibitive costs. Since DoD opted to use commercial transportation assets for ammunition shipments, they were forced to establish security guidelines that satisfied military requirements and were within the transportation industry's capabilities. The DoD adopted existing UN hazard classifications as the basis for identifying the appropriate level of security required for each shipment and implemented the standards stated herein.

6. Department of Defense-Authorized Munitions Carriers

There are currently 17 motor carrier companies and four major railroad companies that are capable of providing the required security measures for transporting DoD munitions [Ref. 21,22]. Potential munitions carriers must state an interest in transporting DoD AA&E and demonstrate the ability to provide the required levels of security to be DoD authorized. The following is a list of DoD authorized carriers [Ref. 21,22].

Motor Carriers

Baggett Transportation	T. F. Boyle Transportation, Incorporated
Carroll Trucking	Chalich Trucking
Davis Transport	Diablo Transportation
Kando Canadian Carrier	Federal Freight Systems, Incorporated
Landstar Inway	Landstar Ranger, Incorporated
Prestera Trucking	Roberts Express, Incorporated
Salt Lake Transfer	R & R Trucking, Incorporated
Yowell International	Tri-State Motor Transit, Incorporated
C. I. Whitten, Incorporated	

Railroad Companies

Burlington Northern/Santa Fe	CSX
Norfolk Southern	Union Pacific

7. Breakbulk Cargo

Breakbulk involves moving individual pallets of ammunition and is quite labor intensive. Moving ammunition in breakbulk is most advantageous when there is low cargo volume, or insufficient facilities to off-load a container. [Ref. 7:p. 21] The Navy resupplies its ships using breakbulk shipments from inland ammunition depots to ammunition ports due to Underway Replenishment (UNREP) restrictions and containerization efficiency issues. Navy ammunition operations are not easily adaptable to standard containerization for the complete movement from depot to port. The Navy

can't UNREP a container, and shipments of munitions from depot to port are small enough to make it inefficient to containerize them. Underway replenishment involves transferring cargo from one vessel to another while at sea. Replenishment vessels do not have adequate space to store containers or the equipment to transfer them to another ship while underway. Other issues that limit Navy containerization include the time to block and brace a munitions shipment in a container at the depot only to unload the container at the port for distribution to ships, 20 ft. container availability, and Container Handling Equipment (CHE) limitations at the depots. [Ref. 4] The Defense Transportation System (DTS) relies on commercial industry for technological improvements and methods of shipping cargo. Breakbulk shipping is no longer economically viable in commercial shipping operations since the development and wide-spread use of containers and container ships. [Ref. 7:p. 21]

8. Containerized Cargo

"Containerization is a method of distributing merchandise in a unitized form thereby permitting an intermodal transport system to be developed providing a possible combination of rail, road, canal and maritime transport" [Ref. 23:p. 368]. Containerization is also defined as "using box-like devices to store, protect and handle a number of packages as a unit of transit, [utilizing a] shipping system based on large cargo-carrying containers that can be interchanged between trucks, trains and ships without rehandling contents" [Ref. 24:p. 256]. The preferred method of moving ammunition is in containers because of the efficiencies in handling and storage that containers provide. Containerization reduces delivery times of resupply by reducing

handling, loading, and unloading times. Containerization is an efficient way to move large volumes of munitions when compared to breakbulk. However, the equipment required to move, store, and load many pallets containerized as a single unit load is capital intensive. [Ref. 7:pp. 20-21] The DoD is improving its container handling infrastructure through the recent purchase of a gantry crane for each of the West Coast ammunition ports and one commercial lift truck for each of the Tier I and II depots [Ref. 25].

C. MUNITIONS MOVEMENT REQUIREMENTS

1. Peacetime

On average, 76 percent of the total weight of Department of Defense ammunition is transported by motor carrier (truck) and 24 percent by rail (see Appendix B for computations). The goal of the Department of Defense is to increasingly containerize its ammunition and change the transportation ratio to 90 percent rail and 10 percent truck. [Ref. 23] Table 2.5 lists the number of shipments, by mode, from the eight Tier I and II ammunition depots to the three DoD ammunition ports. Data for truck movement of ammunition was obtained from the Defense Transportation Tracking System; the number of rail movements was approximated using a 76 percent truck, 24 percent rail ratio.

Year	Motor Carrier	Rail
1995	1372	195
1996	1179	168
1997	1793	255
1998*	757	108

*1998 data only includes shipments through June.

Table 2.5. Ammunition Shipments by Transportation Mode [Ref. 26].

2. Mobilization

The Mobility Requirements Study (MRS) of 1992 and the Mobility Requirements Study Bottom Up Review Update (MRS BURU) of 1995 specified transportation requirements for mobilization in response to a Major Regional Contingency (MRC). MRS BURU requires shipping 924,000 tons of munitions from the eight Tier I and II depots to the three DoD ammunition ports in 16 weeks. MRS BURU assumes maximum containerization implying approximately 90 percent of all ammunition is shipped in 20-foot containers; the remaining ten percent is shipped as breakbulk. This assumption is based on current trends in the commercial sector toward increased containerization. The breakbulk requirement includes Navy ammunition, sustainment ammunition being shipped by air, and the Army ammunition basic load that is not included in the MRS-BURU requirements. The DoD goal is that 90 percent of the total weight of munitions transported will be by rail and ten percent by truck. Truck transportation usage is assumed to encompass the Navy's breakbulk requirement for ammunition resupply. [Ref. 22]

During Desert Shield/Desert Storm, 477,000 tons were moved from 21 depots to three ports. Ninety-five percent of the ammunition was shipped breakbulk and required

5500 trucks and 5650 railcars over 32 weeks. [Ref. 22] MRS BURU requires 46 percent more ammunition to be shipped from depot to port in half the time required for Desert Shield/Desert Storm. If the total weight was transported entirely by truck, it would require 41,067 trucks. If the total weight was transported entirely in rail boxcars it would require 18,480 boxcars. If transported entirely containerized it would require 66,475 TEU containers. Basing transportation requirements on the Department of Defense's goal of 90 percent rail, ten percent truck produces a requirement for 29,914 railcars, and 4,107 trucks over 16 weeks (Appendix B).

D. AMMUNITION TRANSPORTATION RELATED EXERCISES

DoD incorporated lessons learned about efficiently transporting ammunition during Operation Desert Shield/Desert Storm as recommendations in the Mobility Requirements Study (MRS) of 1992. The attention the MRS gave to ammunition prompted the United States Transportation Command (USTRANSCOM) to develop exercises to test and develop the intermodal ammunition transportation. In order to more accurately assess ordnance requirements and the logistics process involved during mobilization for a MRC, the Joint Ordnance Wargame was developed. Exercises and wargames provide a tool for identifying issues and shortfalls affecting ammunition transportation before an actual requirement exists.

1. TURBOCADS

The United States Transportation Command realized that the uniqueness of ammunition presented a number of obstacles to effectively using intermodal

transportation and developed a series of exercises to address and study ammunition transportation. These exercises, called TURBOCADS (Containerized Ammunition Delivery System), were designed to stress CADS capabilities and to assess commercial industry's ability to support containerized munitions transportation requirements. [Ref. 11]

TURBOCADS exercises identify potential shortfalls in the transportation system that could prevent the routine continuous use of containerized muntions. TURBOCADS exercises test on-hand container handling equipment throughput at depots and ports and identify container-handling shortages. They also test container throughput at ammunition ports. They found a shortage of CHE at depots and ports and that borrowing or leasing equipment is standard practice at installations with shortages. This presented an obstacle in the smooth operation of containerized ammunition transfer. Another major finding was the low container throughput at the West Coast ammunition ports. Dedicated container cranes did not exist at these ports and throughput suffered as a result. Each year, a subsequent TURBOCADS exercise is designed to improve lessons learned from the previous exercise and test a different area of the containerized ammunition pipeline. [Ref. 7:p. 77]

2. JORDWAR

The Joint Ordnance Wargame (JORDWAR) is a munitions-based, joint logistics wargame. It evaluates near-term ammunition logistics, identifies challenges in material, transportation, and facilities, and develops recommendations to improve ammunition logistics from origin to destination. The Joint Ordnance Wargame 1997 was conducted at

the Naval War College. It utilized a dual MRC scenario based on current CINCs Operations Plans (OPLANS) to generate data and analysis. [Ref. 27]

Ammunition transportation infrastructure capabilities are tested during JORDWAR. More specifically, container availability and size, Material Handling Equipment (MHE), Container Handling Equipment (CHE), and mode assets are tested to identify potential problems. The wargame found that, with minor modifications, an adequate number of ammunition grade commercial 20-foot ISO containers exist to handle surge requirements. Commercially leased containers require the addition of two door post retainer bars to be suitable for ammunition shipments. A related issue is whether to use 40-foot containers for munitions; commercial industry is moving to that standard size. However, with the density of ammunition, an average load weighs out in a 20-foot container before it cubes out. Furthermore, military CHE, already in short supply, is designed to handle 20-foot containers. Therefore, it would not be practical, or efficient, to use 40-foot containers for muntions. The wargame found that shortages in MHE and CHE negatively affects throughput at depots and ports. Rail and trucking industry trends also impede the flow of munitions. [Ref. 22] Specific industry trends will be discussed in more detail in Chapter III.

E. CONCLUSION

Ammunition is the primary means by which military objectives are achieved. There is necessarily a multi-faceted collection of organizations within DoD managing ammunition to ensure it is available in sufficient quantities to meet the warfighter's needs. Munitions require a large transportation infrastructure. Historical data of

peacetime shipments reveal current shipment trends while MRS BURU identified DoD goals for shipping ammunition during mobilization. Department of Defense goals are based on transportation industry trends that would yield maximum efficiency and effectiveness in ammunition transportation. Analysizing modal characteristics is warranted to assess the feasibility of DoD's goals.

The next chapter identifies the primary modal characteristics and their differences as they affect munitions transportation. Equipment capabilities and limitations, availability, accessibility to ammunition installations, and other issues affecting carrier performance will be presented.

III. TRANSPORTATION INDUSTRY CAPABILITIES

A. INTRODUCTION

It is important to know types of equipment, weight limitations, equipment availability, and modal access to ammunition installations, as well as other factors that could affect the ultimate performance of a munitions carrier. When making the decision about which mode of transportation is most appropriate for a particular shipment, each mode has different characteristics. This chapter analyzes each of these factors for rail and motor carrier transportation to identify the information necessary to make modal decisions.

B. RAIL

1. Cargo Weight Limitations

The Army's Industrial Operations Command indicates the weight limitation for boxcars used for breakbulk shipments of ammunition is 100,000 pounds [Ref. 28]. The weight limitation used by MTMC's Operations and Plans Office for determining 20-foot intermodal container requirements is 27,800 pounds [Ref. 22]. These limitations are important when determining mode of transportation and whether to ship using a boxcar or container. There are many other factors to consider when making the decision whether to use rail or truck, boxcar or container but with all other factors being equal the mode with the greater capacity would be preferable. A goal is to minimize material handling in order to minimize the costs associated with it.

2. Security

Another important consideration in mode selection is the security each mode is capable of providing. Depending on the shipment's Security Risk Category (SRC), security may be a deciding factor in mode selection. The rail industry can provide Rail Armed Guard Surveillance Service, Military Traffic Expediting Service, and Rail Inspection Service as discussed in Chapter II. Security Risk Category I material is the only category that requires an armed guard; SRC II, III and IV material only requires inspection service. For SRC I material, the armed guards are not located in or on the railcar in which the ammunition is shipped. The only way an armed guard can maintain positive visual surveillance of the railcar is if it is located adjacent to the locomotive or at the end of a train using a caboose. Military Traffic Expediting Service is required for all rail ammunition shipments.

3. Equipment

Rail equipment used for shipping ammunition includes boxcars (see Figure 3.1), containers and railcars capable of carrying 20-foot containers, often called intermodal cars. Boxcars are used for breakbulk ammunition shipment while containers are used when the ultimate destination is outside the Continental United States (OCONUS) and could require transfer aboard a vessel for shipment overseas.

There are various types of intermodal cars, including 60-foot flatcars, 89-foot flatcars, articulated spine cars, and double-stack well cars. DoD prefers single deck, 60 and 89-foot flatcars because they can be used for either unit equipment or Container on Flatcar (COFC) shipments. The 60-foot flatcars are capable of handling three 20-foot

containers. The 89-foot flatcars are capable of handling four 20-foot containers. In the 1970's, the conventional 89-foot flatcar was the industry standard, but commercially-held inventories of 89-foot flatcars are dwindling. Railroads have been getting rid of these flatcars because of their low commercial demand. Many commercially-held 89-foot single deck COFC cars are being converted to bi-level automobile railcars [Ref. 3]

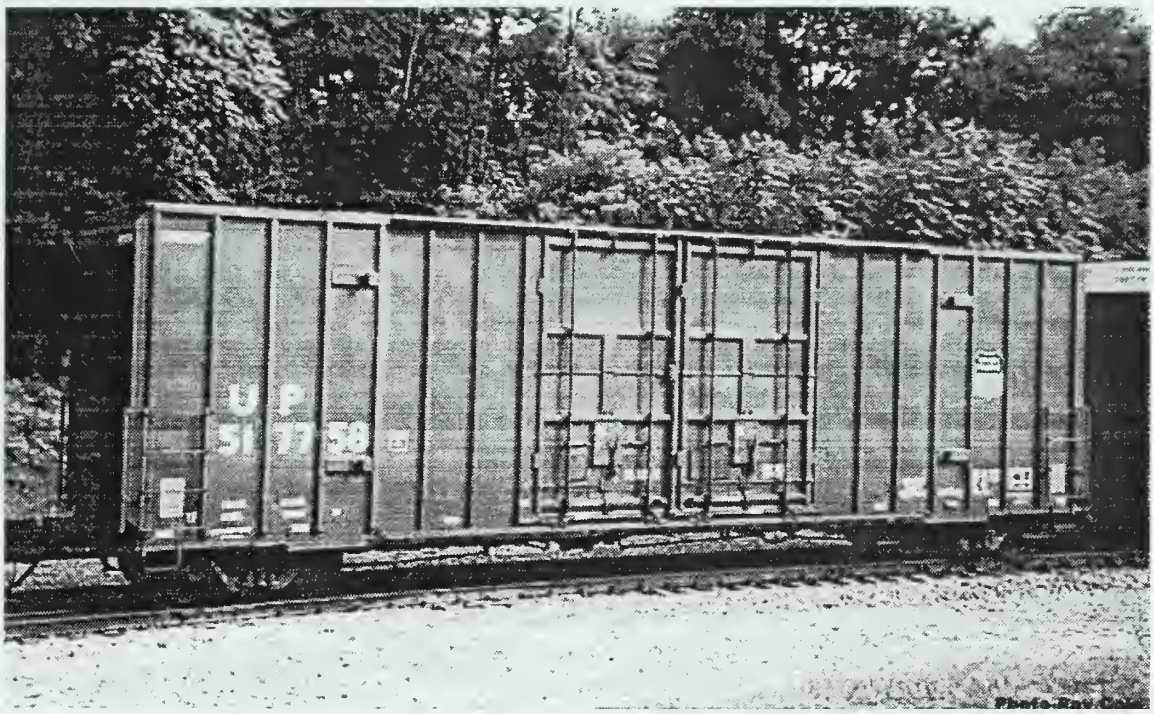

Figure 3.1. Boxcar.

Spine cars are lightweight to improve fuel efficiency, designed to provide damage-free ride characteristics and can carry five containers. Double-stack cars refer to containers moving on equipment that can be loaded with one container placed on top of another. A common configuration is five-unit articulated double-stack cars capable of carrying ten 40-foot containers, although 20-foot containers are not carried in the top position of a double stack car. [Ref. 24] (See Figure 3.2)

Figure 3.2. Double-stack Railcar.

Several different 20-foot containers are used to transport ammunition. Some of the most common include Ammunition Restraint Military Van (MILVAN) end- opening containers, commercial International Standards Organization (ISO) end-opening containers, and side-opening containers. End-opening units are the most common intermodal containers in the inventory. The large majority only open at one end, but some double end-opening containers exist. Other less common containers or container loading equipment include the 20-foot half-height container, 20-foot flatrack, load and roll pallet (LRP), and container roll-on/off platform (CROP). [Ref. 29:pp. II-7—II-21] The end-opening container will probably be the Department of Defense's predominate container system. It is currently the commercial shipping industry standard (Twenty-foot

Equivalent Unit) and is familiar to DoD personnel who work with handling and stuffing/unstuffing containers. [Ref. 7:p. 31] (See Figure 3.3)

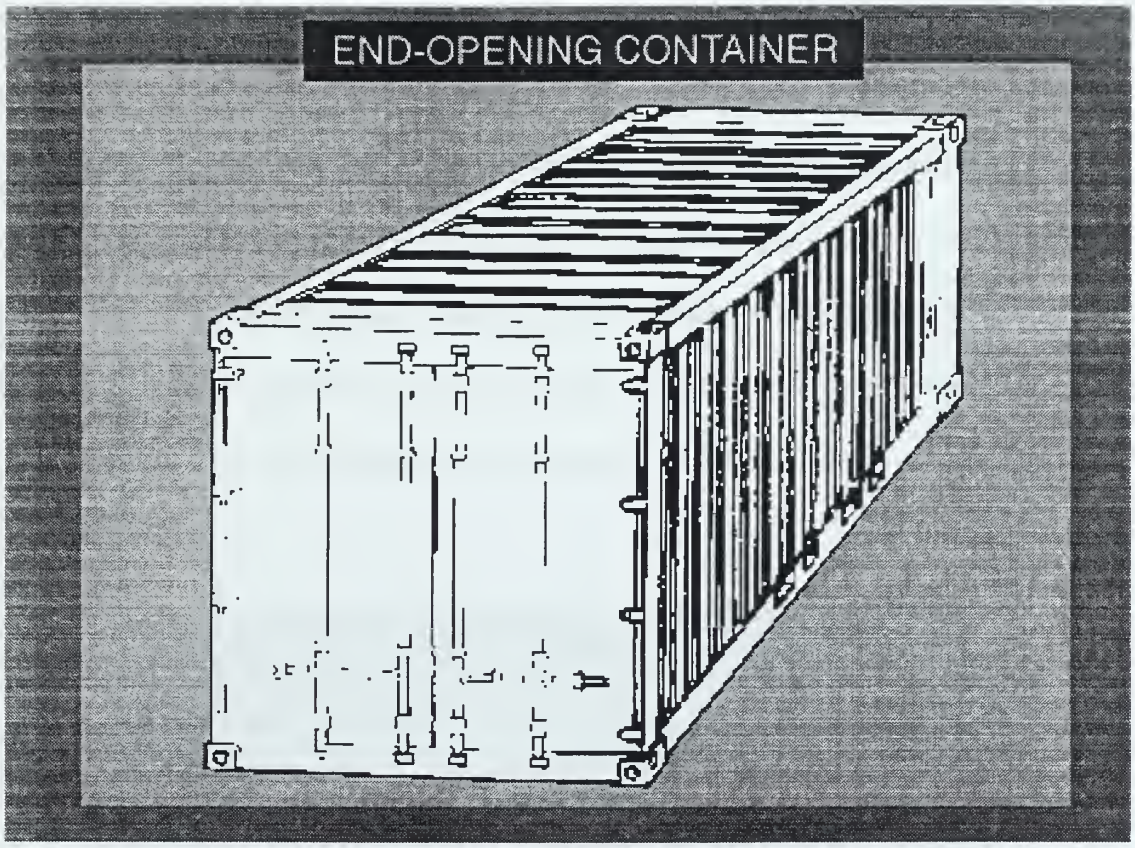

Figure 3.3. End-opening Container [Ref. 29:p. II-8].

The Ammunition Restraint MILVAN is made of steel with wood floors and walls. It has an internal restraint system of eight slotted steel rails permanently installed on each sidewall with 25 adjustable crossbars that can be inserted into the slots. Forklift pockets are placed along the bottom for easy Container Handling Equipment (CHE) access. [Ref. 29:p. II-7]

Commercial 20-foot containers can be used to transport ammunition as long as their door-end corner posts have been modified with angle irons to enhance blocking and bracing of ammunition loads. Since there is no permanent restraint system, as in the

MILVAN, wooden blocking and bracing is used to restrain munitions. These containers have standard handling fittings on the top of the container as well as forklift pockets along the bottom. [Ref. 29:p. II-7]

A Load and Roll Pallet (LRP) is a steel frame designed to fit inside a standard ISO container. It has rollers on one end so the load can be rolled in and out of a container by lifting the non-roller end of the pallet with a forklift or winch. This system is used exclusively for transporting missiles, including four Multiple Launch Rocket System (MLRS) pods or four Army Tactical Missile System (ATACMS) pods. The MTMC controls approximately 500 LRP units in the DoD inventory. [Ref. 7:p. 34] (See Figure 3.4)

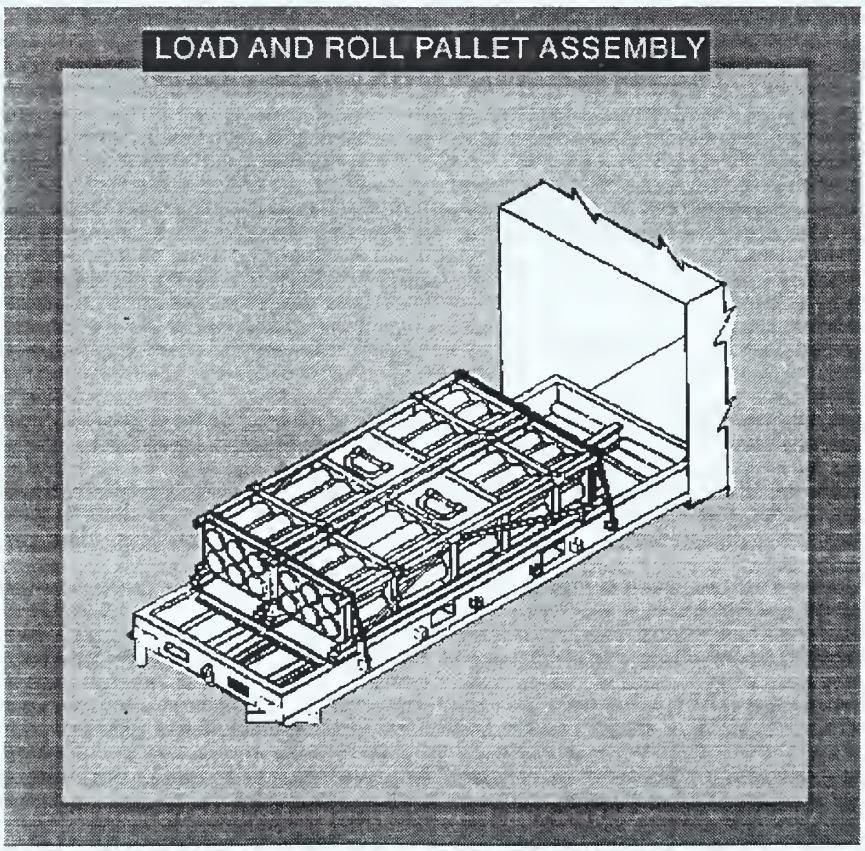

Figure 3.4. Load and Roll Pallet Assembly [Ref. 29:p. II-21].

The Container Roll-On/Off Platform (CROP) is a piece of handling equipment that fits inside a standard ISO container. It has a rolling mechanism that provides for easy loading and unloading. It has locking mechanisms in the front and rear that self-lock when the platform is loaded. The CROP is conceptually similar to the LRP; the LRP is specialized for missiles while the CROP is designed to accommodate a variety of commodities, including most types of ammunition. [Ref. 7:p. 37]

Side-opening containers are ISO containers with two double doors located on one side that allow easy access to the container's contents. These containers are fitted internal tie down points for securing ammunition. It is easy for almost any forklift to reach the cargo, so this container is used successfully with many different sizes and types of ammunition. [Ref. 29:p. II-11] (See Figure 3.5)

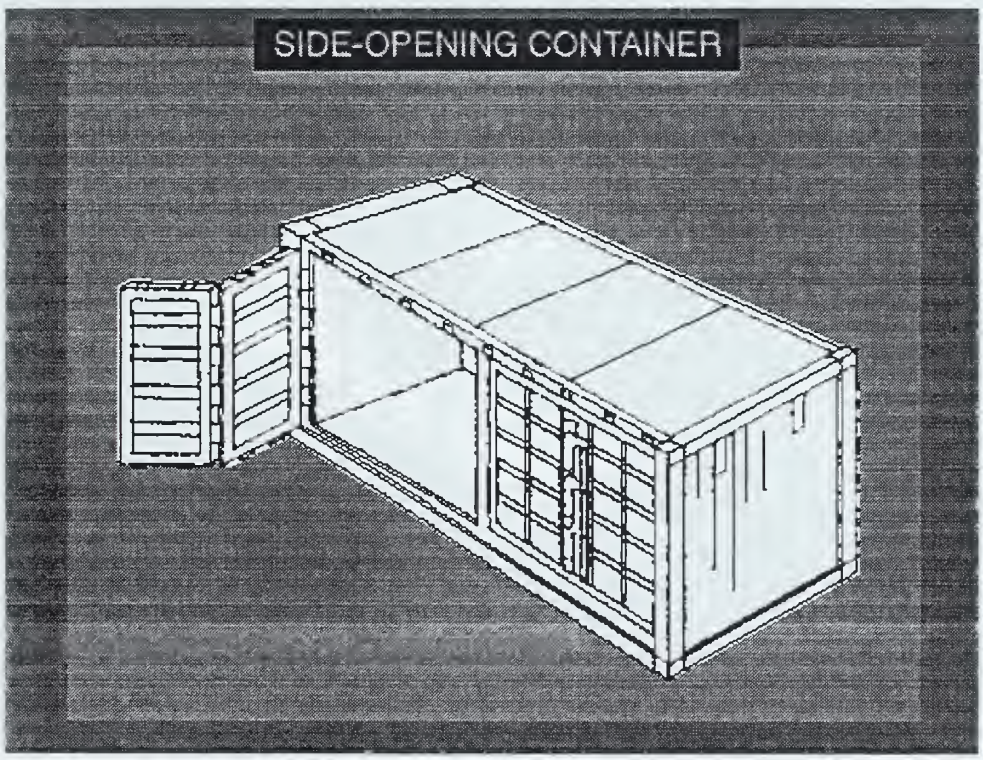

Figure 3.5. Side-opening Container [Ref. 29:p. II-12].

Half-height containers have the footprint of a normal 20-foot container, but are half the height. It has standard structural members and corner fittings, an open top and one drop-end opening. Contents are easily accessible by Materials Handling Equipment (MHE) or crane. Although it does not have a top, contents are protected from the elements by tarpaulins during shipment and storage. They are useful for transporting very dense ammunition with small vertical dimensions. However, they are not very useful for ammunition requiring higher security levels. [Ref. 29:p. II-11] (See Figure 3.6)

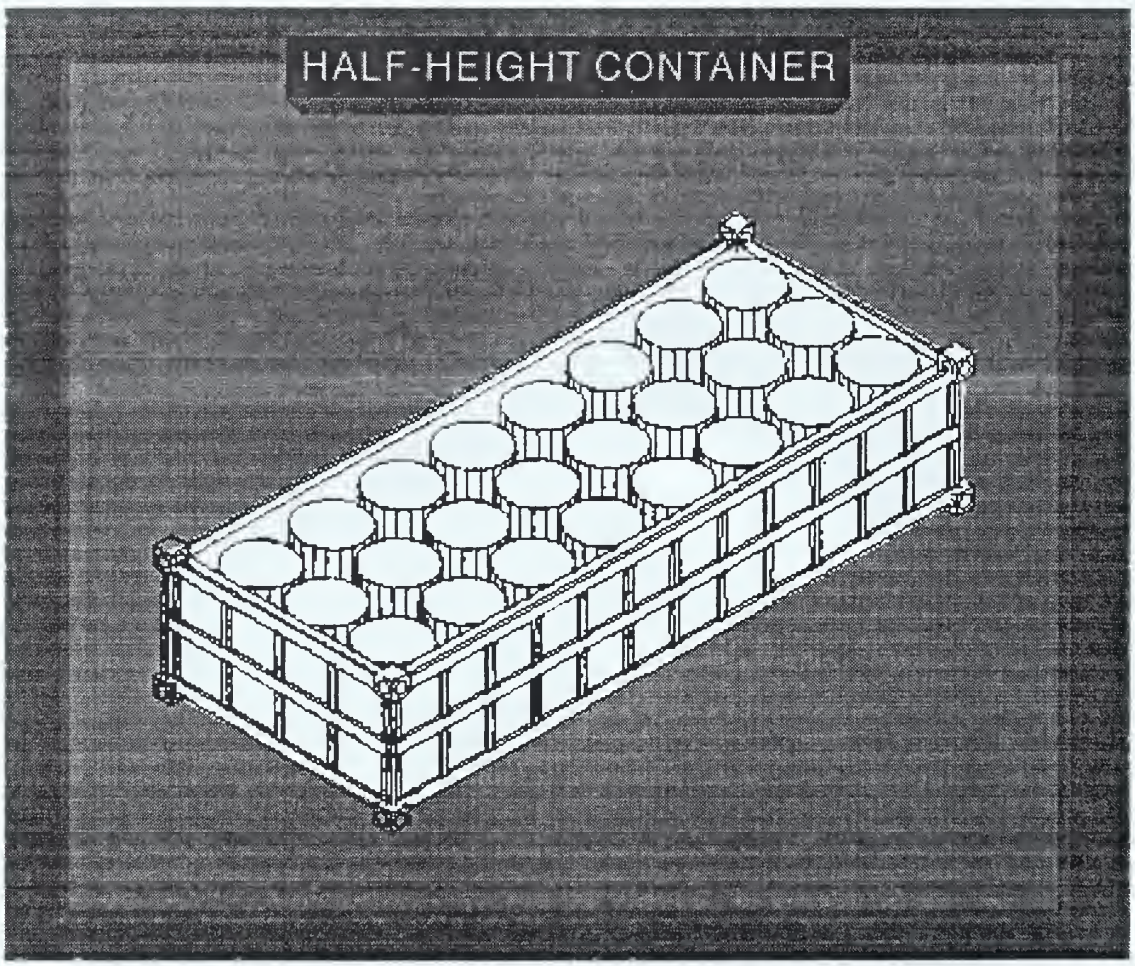

Figure 3.6. Half-height Container [Ref. 29:p. II-15].

A flatrack is a shipping platform with no top or sides; it may or may not have end-walls. Flatracks are used to transport high cube munitions, that are slightly larger than the eight-foot high by eight-foot wide dimensions of a standard ISO container, and have container handling fittings and forklift pockets. Because of its obvious lack of security, it is the least desirable type of container to transport ammunition. [Ref. 7:p 34] (See Figure 3.7)

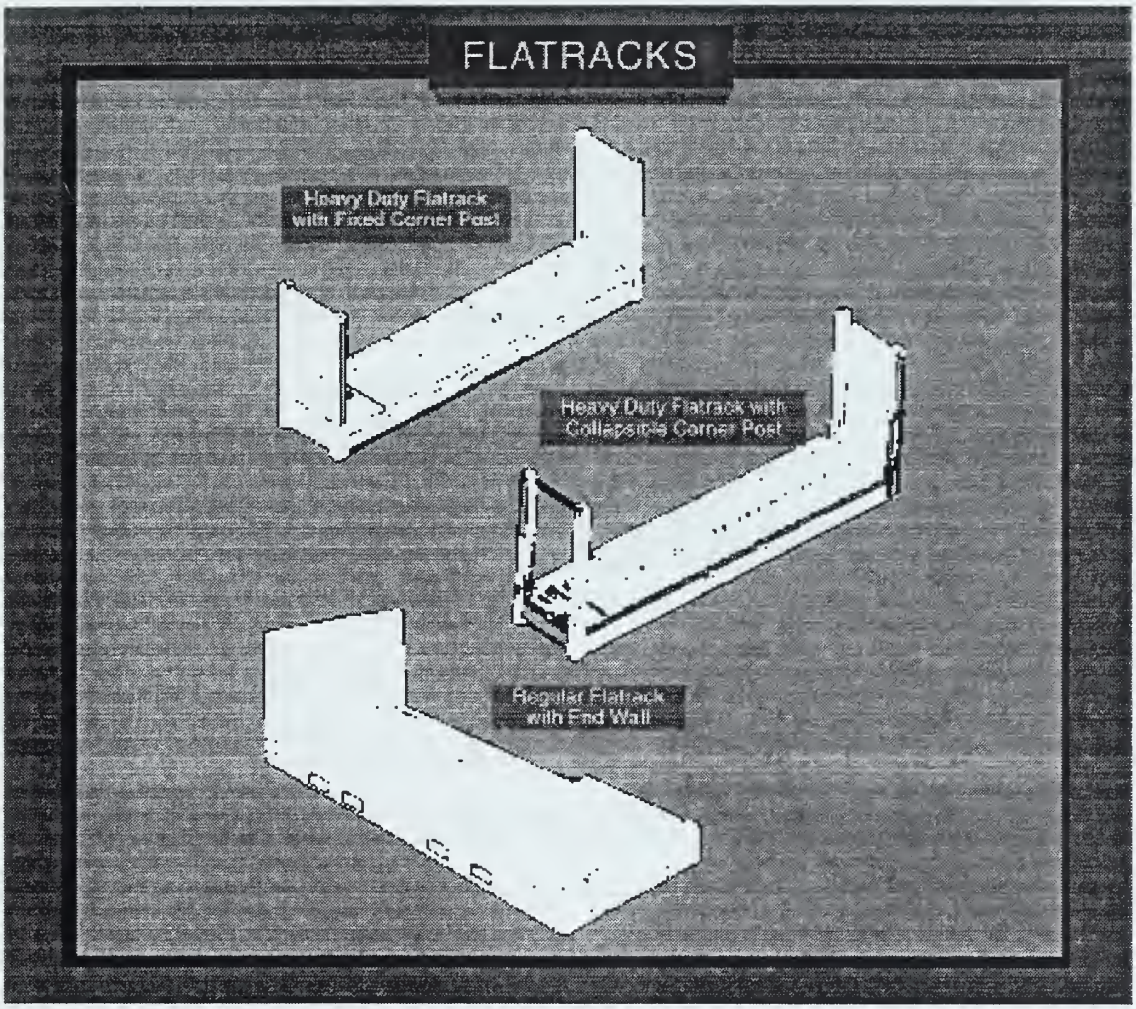

Figure 3.7. Flatracks [Ref. 29:p. II-20].

There are numerous types and variations of MHE and CHE used by ammunition depots and ports. Some of the more common types include forklifts, Rough Terrain Container Handlers (RTCH) with Top Handlers, and Rough Terrain Container Cranes.

The forklift, or lift truck, is considered the "workhorse" of MHE. Forklifts can be battery powered or powered by an internal combustion engine using gasoline, propane, or diesel fuel. Using a counterbalance, forklifts can carry up to 100,000 pounds and handle height capacities up to 30 feet. The main advantage of forklifts is their flexibility and relatively low cost, approximately $30,000 per forklift. [Ref. 30:p. 206] Forklifts can be used to load and unload railcars and containers of virtually any dimensions.

The Rough Terrain Container Handler (RTCH) with top handler can both lift individual 20-foot, 35-foot, or 40-foot ISO containers with gross weights up to 50,000 pounds and carry them over improved or unimproved terrain such as soft soil and beaches. A special fork kit is also available to lift 20-foot half-height containers, flatracks, and containers with fork pockets as the only available lift fixture. The RTCH is a four-wheel drive vehicle capable of fording up to five feet of water. The RTCH provides extensive flexibility for container handling in the field. [Ref. 29:p. II-22] This equipment, however, is not capable of loading containers of any length into the "well" of intermodal railcars. It is limited to loading and unloading single deck railcars [Ref. 25]. (See Figure 3.8)

The Rough Terrain Container Crane (RTCC) is a wheel-mounted crane capable of lifting a fully loaded 20 or 40-foot ISO container. This equipment can be used to augment the RTCH in transferring containers and other cargo between transportation

modes and storage areas. The RTCC can be operated on hard surfaces or on soft surfaces with wooden platform sections to support the weight. [Ref. 29:p. II-22] (See Figure 3.9)

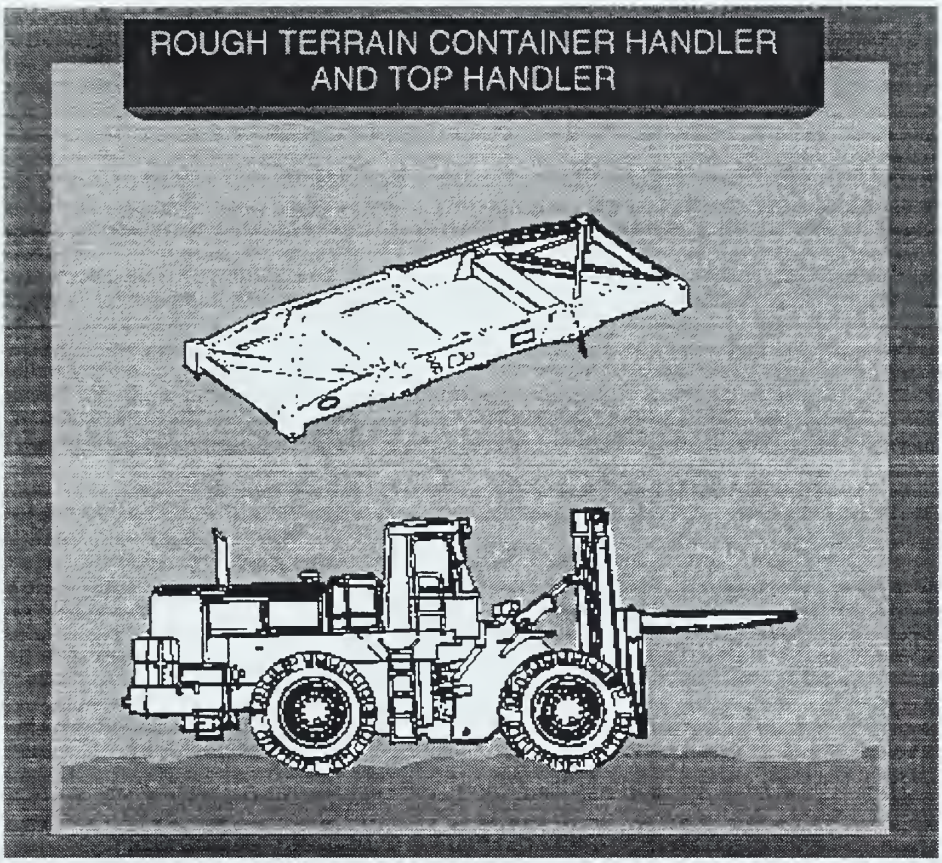

Figure 3.8. Rough Terrain Container Handler and Top Handler [Ref. 29:p. II-25].

There are standards and inspection criteria for boxcars, containers and intermodal cars. Twenty-foot containers that meet the physical inspection criteria can be used to transport munitions. The physical inspection criteria for boxcars includes suitability of the cargo space for loading and railcar mechanical condition, and contamination. The cargo space must be clean, have no protruding nails, screws, or bolts, and all debris and dunnage must be removed. The floors, walls, and roof must be free of holes, cracks, loose boards, decayed spots, and any combustible or corrosive liquid or solid. Also, the railcar cannot have any exposed metal floor plates. [Ref. 16:p. 3-3]

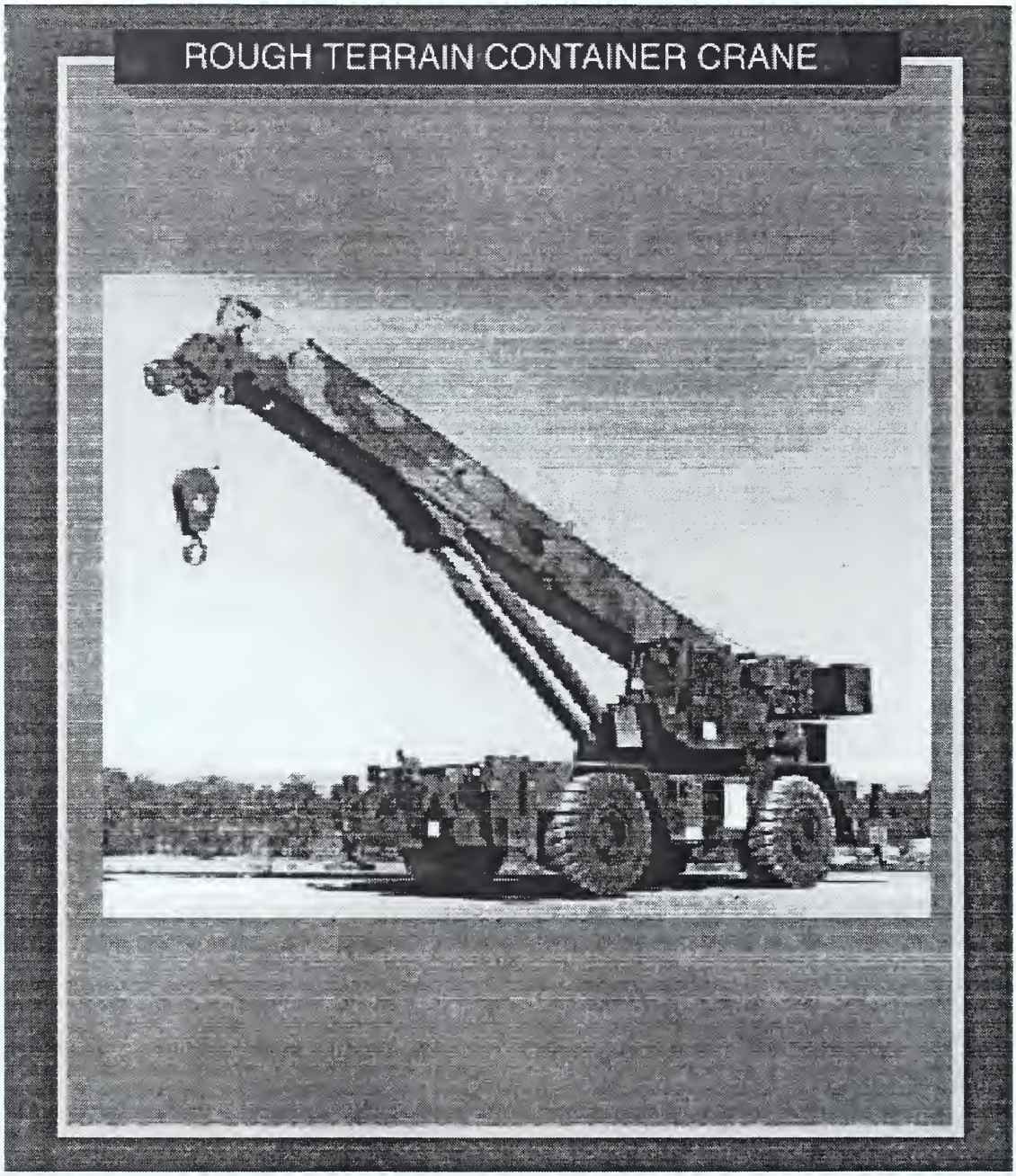

Figure 3.9. Rough Terrain Container Crane [Ref. 29:p. II-23].

The physical inspection criteria for containers include the following items. The doors, weather seals, hinges, and latches must be free from damage and wear. The roof, sides, ends and doors must be free from holes, tears, rusted thin spots, and punctures. There can not be any missing, cracked, or broken welds at the juncture between any primary structural components. Also, the floor must be free of holes and warped or damaged floorboards. [Ref. 16:p. 4-1--4-2] Before a container can be used it must be free of any residue of previous cargo and its interior walls and floor must be free from protrusions. If a container has any safety-related deficiency or damage that could place any person in danger, it can not be used. [Ref. 31:p. 32]

In theory, all single deck and the "wells" of all double stack intermodal cars can be used for ammunition. If a boxcar has a steel floor or spark shields and meets the physical inspection criteria it can be used to ship ammunition [Ref. 25].

4. Twenty-foot Container and Railcar Availability

The majority of containers in the United States inventory are of the 20- and 40-foot variety. The inventory of each type is continuing to grow, as shown in Table 3.1; the 40-foot inventory is growing much faster than the 20-foot inventory. Commercial inventories of the 20-foot side opening, flatrack, and half-height containers are shrinking due to decreased demand. At this time, the 20-foot ISO container is the DoD standard size for moving ammunition. [Ref. 29:p. II-6]

While it is useful to monitor trends in the quantity of commercial containers, asset availability is a more important factor. A key factor in determining availability is the quantity of lessor-owned containers not already under lease to a DoD shipper or ocean

carrier. This is the additional supply available for lease by the Department of Defense. This quantity is referred to as the "off-hire rate" and is expressed as a percentage of all lessor-owned containers. Its value depends largely on the balance of trade. A favorable balance of trade will increase the demand for containers for overseas shipment, decreasing the number of off-hire, or available, containers within the United States. Therefore, worldwide economic conditions dictate the number and location of containers which are available for DoD use. In recent years, a specific niche has been established for the standard 20-foot container serving geographic regions with less intense shipping requirements and lesser-developed infrastructures. The off-hire rate for these niche commercial assets has generally decreased. [Ref. 29:p. II-7]

Container Type	1990 Quantity	1994 Quantity	Percent Change
20-foot ISO box	833,042	1,304,913	56.6
40-foot ISO box	618,966	1,193,753	92.2
20-foot side-opener	446	85	-80.9
20-foot flatrack	18,728	13,472	-28.1
20-foot half-height	1,193	727	-39.1

Table 3.1. Trends in U.S.-Owned Commercial Container Fleet [Ref. 29:p. II-6]

There are currently 1.44 million 20-foot containers and 1.36 million 40-foot containers in the U.S. commercial inventory, but rail and vessel fleets are becoming more frequently designed for 40-foot containers in an effort to increase efficiency and cope with potential capacity shortages. Only 43 percent of COFC capacity is 20-foot container compatible and only 23 percent of the slots in the U.S. flag vessel fleet are configured for 20-foot containers. [Ref. 3:p. 23] This portends a longer term potential for reduction of the percentage of 20-foot containers available. Based on a 1997 DoD survey, conducted

in conjunction with JORDWAR 97, the available 20-foot containers tend to have a lower likelihood of meeting ammunition standards as the fleet grows older [Ref. 3:p. F-6].

In response to this trend, approximately 5,000 containers were purchased and placed in the Containerized Ammunition Distribution System (CADS) fleet. These containers were distributed between the eight Tier I and II ammunition depots and reserved for surge capacity in response to a contingency. [Ref. 3:p. III] JORDWAR 97 concluded that sufficient ammunition-quality commercially-held 20-foot container assets were available for peacetime and contingency use. The largest concentrations of assets are in major port areas and can be delivered within one or two days, even with short notice. [Ref. 3:p. F-4] That ensures that sufficient containers are available when they are needed, but it doesn't address the problem of transporting those containers.

The Department of Defense policy to use commercial transportation assets to the maximum extent until they fail to meet shipping requirements results in government-owned railcars being held in reserve to meet surge requirements; eight percent of commercial intermodal cars are ammunition capable. This number is based on the ability to carry 20-foot containers and the ability of DoD CHE to load them. It is difficult for railroads to identify and locate munitions capable railcars because they are randomly dispersed throughout the U.S. in daily revenue service. The problem is compounded because there is no centralized railroad management organization that exists to track this specific type of railcar. TTX Company, previously Trailer Train, owns and assigns cars to individual participating companies that manage the assets to meet their own shipping obligations. To address this problem, DoD recently procured 321 89-foot flatcars to

prevent surge shortfalls in available equipment. The Department of Defense plans to buy an additional 349 cars. [Ref. 3:pp. II, F-10]

There are other important industry trends that will affect industry's capability to support ammunition transportation requirements. First of all, the pool of available railcars is reduced by the increasing trend to link cars to specific shippers under rail contracts. According to 1994 data, 69 percent of railroad tonnage is derived from contracts [Ref. 3:p. 20]. Obviously, other customers cannot lease railcars if they are already in use.

The supply of RTCH-compatible commercial flatcars is rapidly declining. The commercial rail fleet of 89-foot single deck COFC cars, compatible with military design RTCH equipment, is being converted to bi-level automobile railcars. Prior to the widespread use of double-stack equipment, the 89-foot flatcar was the primary intermodal car with over 14,000 cars. Table 3.2 shows the trend in number of 89-foot flatcars.

Date	Number of 89-foot flatcars
1 January 1997	4,401
1 January 1998	2,288
1 January 1999	1,000

Table 3.2. Number of 89-foot Flatcars [Ref. 25].

The single deck COFC capacity is being replaced with double-stack well cars. TTX's four year acquisition plan for intermodal equipment, covering 1998 through 2001, calls for purchasing 39,131 new platforms, of which 33,284 (approximately 85 percent) will be double-stack. The remaining 5,847 platforms in the acquisition plan will be

single-deck three unit all-purpose spine cars capable of carrying 40- to 53-foot containers or trailers ranging from 28 feet to 53 feet in length. These single deck cars are not capable of handling 20-foot containers. [Ref. 25] Ninety percent of overall COFC/TOFC capacity is made up of double-stack cars, which are not compatible with RTCH equipment. [Ref. 3:p. IV] Current ammunition capable commercial railcars are restricted to 28,000 20-foot slots because of CHE limitations [Ref. 3:p. F-14]. The Department of the Army has procured eight commercial lifts, capable of loading well cars, to be located at each of the Tier I and II ammunition depots to start to address the issue [Ref. 25]. This action increases the number of 20-foot slots to 112,000, which is 31 percent of the commercial fleet [Ref. 3:p. F-14].

Standard 50-foot boxcars are used for non-containerized rail shipments of ammo. Department of Defense rail fleet plans call for a projected end strength of 888 interchange certified boxcars for use on depot and to meet navy breakbulk requirements. The standard U.S. 50-foot boxcar fleet stood at 60,000 on 15 January 1999, with limited numbers of boxcars being built to meet specific shippers' requirements. As a non-contract shipper, boxcar as well as other types of rail equipment availability during peacetime depends on the capacity that contract shippers are not using at any given point in time. Sufficient boxcars exist in the commercial inventory to support DoD peacetime breakbulk requirements; the commercial inventory can support surge requirements during war through the Defense Production Act, if necessary. [Ref. 32]

5. Access

All ammunition depots have rail access. It is a different story for the ports. Concord is the only port with commercial rail access. Concord is served by the Union Pacific Railroad, which passes through the tidal area [Ref. 33:p. 17]. Military Ocean Terminal, Sunny Point is served by CSX Railroad through a transfer facility 18 miles from the terminal; government-owned rail equipment operated by terminal personnel completes the trip to the port [Ref. 13]. The nearest rail access to Port Hadlock is at Bangor, approximately 40 miles from the port; a rail/truck container transfer terminal has been recently constructed in Bangor [Ref. 25].

6. Delays

An issue that can affect railcar availability and transit time is delays. Delays in service can be caused by a variety of situations and decisions. The rail industry, in its pure form, is constrained by the rail networks, which reduces its flexibility. This becomes more of an issue during a contingency surge, but also affects carrier performance in peacetime. It could ultimately affect the modal decision.

In 1996 and 1997, Union Pacific Railroad experienced delays of more than 30 days due to a combination of railcar, locomotive, and track capacity shortages caused by poor management choices. Union Pacific closed two of three rail yards in Houston and then quickly became overwhelmed by the additional traffic through the remaining rail yard. They were unable to handle the increased demand and this resulted in delays. Customers started switching to other rail companies and other more expensive forms of transportation in order to maintain their own level of service. As a result, the other rail

companies began to experience delays as their systems were strained beyond normal levels. The brunt of the growing demand fell on trucking firms, which rushed to purchase new equipment. The trucking companies began to experience driver shortages as the equipment increased. The railroad and trucking delays also affected the seaports. Container ships were delayed in offloading, which caused delays in pulling in. The ripple effect caused by the delays affected customers and consumers alike as prices rose because of shortages. [Ref. 34]

C. MOTOR CARRIER

1. Cargo Weight Limitations

Different types of truck shipments are broken down by weight. Truckload (TL) shipments weigh between 40,000 and 45,000 pounds, less-than-truckload (LTL) shipments weigh between 5,000 and 40,000 pounds, and dromedary shipments weigh less than 5,000 pounds. [Ref. 28] Dromedary shipments, a subset of LTL shipments, are small amounts of ammunition packed into individual containers and loaded onto flatbed trailers. Since each dromedary containers weight limit is 5,000 pounds, LTL shipments range from one to eight dromedary containers. For all intents and purposes, LTL shipments do not exist for ammunition shipments, just dromedary shipments.

Department of Transportation regulations limit individual truckloads of arms, ammunition and explosives to single trailers with a maximum trailer length of 48 feet. Also, for ammunition shipments, total weight for the tractor, trailer, and cargo together cannot exceed 80,000 pounds [Ref. 35]. Maximum weight for a truckload of ammunition

is nearly twice as much as the maximum weight for a 20-foot container. A truckload's weight capacity is less than half that of a boxcar. The total weight of a shipment would determine the most efficient choice of mode and subsequent choice of equipment within that mode. Another consideration that is important when making modal choices is type of security provided by the carrier.

2. Security

The trucking industry is required to provide satellite tracking and dual driver protection for ammunition shipments. For the purposes of security requirements, truck shipments are either TL or LTL; dromedary shipments are included in LTL shipments. Material in all Security Risk Categories must be trackable by satellite. Security Risk Category I and II materials require dual drivers that have had national agency checks; Category III and IV materials require protection by dual drivers, but national agency checks are not necessary. One driver must be within ten feet of the shipment at all times, so there is always positive visual surveillance and the shipment is never out of the drivers' control. Drivers can immediately notify authorities via the Defense Transportation Tracking System (DTTS) in an emergency.

3. Equipment

The equipment used by the trucking industry to transport munitions includes tractors, trailers, vans, flatbed trailers and chassis. The type of equipment is determined by the size of the shipment. The size of a trailer is unimportant as long as it is pulled by a DTTS equipped tractor. There are currently 1,453 DTTS equipped tractors in the

trucking industry's inventory [Ref. 21]. The Department of Defense requires straight frame container chassis with twist-locks for transporting containerized ammunition. Straight frame chassis make up only 25 percent of the current global inventory; that percentage is declining as commercial industry is switching to slip frame chassis [Ref. 3:p. 23].

There are physical inspection criteria for motor vehicles, similar to rail. In general, the suitability of the cargo space for the load, mechanical condition, and driver suitability is inspected. Specifically, the cargo space must be clean and free of protruding nails, screws, bolts, or any other object that could damage the load. The floors, walls, and roof must be free from breaks, tears, and holes. There can not be any oil, gasoline, or any other combustible or corrosive liquid or solid on the floor, and the tailgates and doors must be capable of being closed, locked, and sealed. [Ref. 16:p. 2-2]

4. Access

All ammunition depots and ports have truck access. The limiting factor is the NEW rating of the staging area. A staging area may have an infinite number of slots filled with a truck, but only if the NEW limit is not exceeded. Conversely, the staging area may have an infinite number of slots with only one truck if that truck's cargo is at the NEW limit. The wide variety of ammunition types and load sizes makes it impractical to establish a NEW limit per vehicle.

D. CONCLUSION

Many factors affect decisions about the transportation mode for munitions. Railcar availability, limitations of container handling equipment, the limited numbers of DTTS tractors, and potential delays in the rail transport system all must be considered. Several trends within each transportation mode potentially limit availability to DoD in the future. All these factors create a complicated problem, but DoD can take actions to maintain the viability of each transportation mode.

IV. AMMUNITION MOTOR CARRIERS

A. AMMUNITION CARRIER DEMOGRAPHICS

In order to better understand the environment in which munitions motor carriers operate, a survey was developed. The questions in the survey were designed to provide information as to the types of firms that provide reliable ammunition transportation. The DoD's goal of 90 percent rail transportation of ammunition will reduce the number of shipments carried by motor carriers. This survey was designed to discover the effect this policy change would have on the motor carrier companies. Issues raised by carriers during the survey are also discussed. A copy of the Trucking Company Questionnaire is contained in Appendix C.

1. Survey Questions

Questions #1 and #2 pertain to the amount of time the company has been in business. These questions ascertained their corporate background. Whether the company is new to the business or has been transporting munitions for several decades suggests their commitment to this market segment. Tenure in the munitions transportation industry could also indicate a company's reliance on revenue generated from DoD munitions shipments.

Questions #3, #4 and #5 pertain to the revenue generated by each company. The goal of this question was to determine the amount of their overall business that was DoD ammunition related. Overall revenue also indicates the company's size. A company with low overall revenue, compared to other motor carrier companies, and a higher reliance on

DoD revenue could be more severely affected if DoD shifts to rail shipments. However, a company with a comparatively high overall revenue and a lower reliance on DoD revenue would be less affected by the shift to rail.

Questions #6 and #7 pertain to the carriers' participation in intermodal ammunition shipments. These questions assess current shipment practices to determine the potential for expanding intermodal shipping in the munitions transportation industry. These questions focused on truck to rail intermodal transfers.

Question #8 pertains to DTTS equipment availability to determine what fraction of the total DTTS-equipped tractors the company could provide. There are many factors to be considered when determining equipment availability, including: equipment maintenance down time, driver availability, and whether the equipment is being used for other non-DoD related shipments.

Question #9 pertains to the munitions carriers' contractual obligations during a contingency surge. This question ascertains if motor carriers have any long-term contractual agreements with DoD, and if a surge clause is contained in the contract. A contractual agreement of this kind would indicate a long-term DoD commitment to munitions motor carriers. It would also indicate the level of planning DoD dedicates to munitions transportation.

Question #10 pertains to the routes taken by munitions carriers when transporting sensitive arms, ammunition and explosives. This question determines the degree to which a company considers the security of an ammunition shipment. A company could take the minimum required security measures to comply with state and federal

regulations, or it could take extra steps to exceed minimum standards. The question was included to provide general information. There are too many factors underlying the potential responses to this question to make judgements about a company.

Questions #11 and #12 pertain to the carriers' equipment and usage. These questions, similar to Questions #3, #4, and #5, determine what percentage of the company's total fleet of equipment was dedicated, or potentially dedicated to ammunition transportation. The question also indicates the predominant segment of the munitions transportation market in which the company operates.

2. Survey Methodology

The 17 DoD authorized munitions motor carriers, identified in Chapter II, were contacted by telephone to conduct the survey. Individuals from four of the companies requested a faxed questionnaire. Four of the companies initially contacted declined to participate in the survey, resulting in a 76.5% response rate (13/17).

Not all of the survey questions were answered by all respondents. All respondents (100%) chose to answer Questions #1, #2, #5, #6, #7, #9, #10 and #11. Questions #3, #4, #8, and #12 were not answered by all companies. Forty-six percent of the respondents chose to answer Question #3. The companies that did not respond to Question #3 indicated that revenue information was proprietary. Sixty-nine percent of the companies responded to Question #12, 85 percent for Question #8, and 92 percent for Question #4.

B. FINDINGS

Responses to the survey are summarized in Table 4.1.

Question #	Demographic	Range of Responses
1	Years in Business	12 – 71 years
2	Years shipping DoD AA&E	5 – 71 years
3	Overall 1998 Revenue	$20,000 -- $400,000,000
4	DoD AA&E Percentage of Revenue	<1% -- 90%
8	Equipment Availability	60% -- 100%
11	Number of DTTS Tractors	2 – 336
11	Total Fleet Size	20 – 3400
11	Satellite Transceiver Equipped Tractors	2 – 3400
12	Percentage of Truckload Shipments	50% -- 100%

Table 4.1. Munitions Motor Carrier Demographic Data.

As noted in the Table, there is wide variability within the carrier group. There appears to be no correlation between age of a company and the fact that the company ships ammunition, although seven of thirteen respondents (54%) have been shipping ammunition for DoD since their business started. The same seven respondents (54%) indicated that DoD AA&E shipments accounted for over 50 percent of their 1998 revenue. The reported data indicates that as overall revenue increases, percentage of DoD ammunition-related revenue decreases. This means that more than half of the motor carrier companies rely on DoD revenue for more than half their annual revenue; as the percentage of rail ammunition shipments increases, these companies will suffer more financial damage. Four of seven respondents (57%) that indicated that DoD AA&E shipments accounted for over 50 percent of their 1998 revenue have also been shipping DoD AA&E for the longest period of time. There appears to be some correlation between how long a company has been shipping ammunition and the percentage of overall revenue that DoD ammunition shipments comprise.

There also appears to be correlation between whether a company began by shipping ammunition or became a munitions carrier at some time after the company's initial start-up and DoD ammunition-related percentage of overall revenue. This reinforces the companies' reliance on DoD ammunition shipments and increases the financial vulnerability of the companies if their market share is decreased by the increasing use of rail. All companies indicated they do not have long-term contractual agreements with DoD. This indicates inadequate DoD planning to ensure access to equipment in time of war. Only one company indicated that its drivers made a conscious effort to vary the routes they took for consecutive shipments from identical shipment origins and destinations.

The number of tractors equipped with the Defense Transportation Tracking System (DTTS) varied widely between the different companies. Numbers ranged from two to 336 DTTS equipped tractors. Percentage of their total fleet that is DTTS equipped ranged between two and 100 percent, with an average of 40 percent and a median of 25 percent. There appears to be no correlation between fleet size and number of DTTS tractors. Six of 13 respondents (46%) indicated that 100 percent of their fleet was equipped with satellite transceivers; other responses ranged from two to 87 percent.

Nine of 13 companies (69%) answered the question pertaining to the percentage of truckload and dromedary (less-than-truckload) shipments carried by their company. Four companies (31%) indicated that they only carry truckload shipments. Truckload shipments ranged from 50 to 80 percent of total shipments for the remaining five companies. All respondents indicated that at least half of their shipments were truckload; the remaining shipments were dromedary.

C. ISSUES

There are a number of issues that have the potential of affecting the future viability of motor carrier ammunition transportation. These issues, if not addressed by DoD, could inhibit several munitions carriers from providing transportation assets to the military in a consistent, reliable manner.

1. Empty Backhaul Shipments

Current practices do not permit an inbound munitions carrier to carry an outbound cargo shipment of any kind, unless the carrier is rated as the lowest cost carrier for the outbound movement [Ref. 36]. This practice increases the carriers' operating costs, and ultimately the DoD's costs, as carriers must charge higher rates to offset the revenue lost by not carrying cargo on return trips. This practice also reduces carrier availability during its return trip.

Current practices regarding ammunition shipment promote inefficiency. Empty outbound carriers is not the most efficient way to transport munitions. A system which maximizes carrier equipment utilization for the inbound and outbound shipment leg would benefit both the carrier and DoD. The carrier would generate revenue for both shipment legs and DoD could receive decreased service rates.

2. Limited Operating Hours at Ammunition Facilities

The logistics industry operates seven days a week, 24 hours per day. However, ammunition installations currently only work four days per week. This is only 19 percent of the time the logistics industry is operating; an 81 percent reduction in the time

available to make deliveries. Trucking companies use two types of drivers to transport munitions, owner-operators and company employees. The majority of driver teams and tractors used to transport munitions are owner-operators [Ref. 37]. These are independent contractors who lease their services and equipment to the motor carrier. Owner-operators must maximize their miles driven because that is their only form of compensation. Any time they are delayed, their revenue is reduced. In addition, regardless of the type of driver used, trucking companies do not make money while their equipment sits idle waiting to unload at ammunition installations.

3. Rates

There is a disparity between the rates motor carriers want to charge for ammunition shipments and the rates DoD is willing to pay. The focus within DoD is to find the lowest cost service. Ammunition transportation is a specialized service provided by only a few motor carriers. There are several requirements for munitions carriers that don't apply to general commodity shippers, all of which increase the munitions carriers' costs. The liability insurance requirement for munitions carriers is approximately double that required for general cargo carriers. As well, munitions carriers must provide dual drivers for each shipment. This requirement means that an additional driver is used for each ammunition shipment; this driver could otherwise be used for revenue producing shipments. Munitions drivers also require special training. National agency checks, when required, are a further expense. The equipment required for satellite tracking costs approximately $5,000 per transceiver. A "panic" button must also be installed, at additional cost, to make the satellite transceiver DTTS compatible.

Receiving payment from DoD is also difficult. One carrier indicated it shipped nine loads of ammunition for DoD in June 1998; as of February 1999 it hadn't received payment for its services.

There are trends within the ammunition transportation market that affect, or should affect rates. Ammunition shipments are diminishing due to the redeployment of forces from Europe and increasing simulated weapons training. The planned shift from motor carriers to rail for ammunition movement further reduces motor carrier shipments. Increasing ammunition containerization also reduces the number of shipments available for motor carriers; the majority of motor carriers use 48-foot enclosed trailers rather than flatbeds. These factors indicate decreasing demand for motor carrier ammunition shipments. The rules of supply and demand indicate that price decreases as demand decreases; the quantity suppliers are willing to supply at the lower price also decreases.

DoD is trying to address two different markets: peacetime ammunition transportation and mobilization ammunition transportation. Over half of the trucking companies indicated that they relied on peacetime DoD munitions shipments for more than half of their revenue. If DoD awards tenders to the lowest cost bidder, then those carriers that cannot offer lower rates and maintain the same level of service will be forced to leave the market. The demand for transportation in the mobilization market is much higher than the demand for transportation in the peacetime market. DoD wants munitions carriers to supply sufficient transportation for the mobilization market while paying rates determined in the peacetime market. This issue is aggravated by empty backhaul shipments. Munitions carriers indicate they would be willing to supply transportation at a

level determined in the mobilization market if supported by demand or prices in the peacetime market.

D. CONCLUSION

None of the trucking companies indicated that DoD shipments comprised 100 percent of their annual revenue for 1998. Through their decisions to not rely entirely on DoD shipments, trucking companies have implied that to do so would not be wise business practice. The percentage of DTTS tractors to total fleet also indicates a reluctance to rely upon the munitions transportation niche market. There are a number of issues that create inefficiencies within the munitions transportation market. The percentage of trucking companies' overall revenue that is comprised of DoD munitions shipments will decrease if the inefficiencies are not addressed. The number of transportation assets available to DoD will decrease during peacetime and sufficient equipment will not be available in the event of a contingency.

V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The final chapter of this thesis provides a summary, conclusions and recommendations based on this analysis of the ammunition transportation industry. Additionally, further research questions are proposed pertaining to efficient and reliable ammunition transportation.

A. SUMMARY

This research has shown that the DoD peacetime conventional ammunition transportation modal combination is, on average, 76 percent motor carrier and 24 percent rail. The DoD's goal for mobilization, as stated in the MRS, is maximum containerization of ammunition transported 90 percent by rail and 10 percent by motor carrier. There is a distinct difference between the two situations. Ammunition shipments during mobilization are characterized by high-volume over a short period of time; peacetime shipments are characterized by lower volume over a longer period of time. To design or plan a transportation system for mobilization while not changing operating procedures during peacetime is inefficient.

The two main factors affecting the ultimate modal combination decision include CHE limitations and the inefficiencies involved with motor carrier transportation. While each of these factors has important implications in wartime scenarios, during peacetime operations there is no mandated ideal modal combination. It is up to the shipper's discretion as to which mode of transportation is best suited for each separate shipment.

B. CONCLUSIONS AND RECOMMENDATIONS

1. Conclusion: Container Handling Equipment limits the types of railcars available for using 20-foot containers.

Container Handling Equipment, and the Rough Terrain Container Handlers (RTCH) in particular, have been the limiting factor in railcar availability. The RTCH have been reliable and quite capable of loading and unloading containers from single deck flatcars. Unfortunately, single deck flatcars are becoming more and more scarce in railcar fleets due to a lack of general consumer demand. Due to its inability to load and unload "well" cars, the RTCH severely limits the number of railcar slots capable of shipping 20-foot containers. With the commercial sector trend toward double-stack well cars, the usefulness of the RTCH in CONUS is waning.

Recommendation: Replace all Rough Terrain Container Handlers in CONUS with Commercial CHE.

Ninety-percent of new intermodal railcars are not RTCH compatible. Replacing the CHE now will not affect the ability to load single deck flatcars but will significantly expand the number of railcars available for munitions transportation.

2. Conclusion: Forty-foot containers can be used for ammunition transportation.

Within the commercial intermodal industry, the 40-foot container is replacing the 20-foot container as the industry standard. Railcars are no longer specifically designed to accommodate 20-foot containers, and a small number of slots are dedicated to 20-foot containers aboard commercial vessels. A typical 20-foot container load of ammunition

will weigh-out before all available space is utilized due to the density of ammunition. Therefore, the additional size of a 40-foot container would not be efficiently utilized. While it is inefficient to use 40-foot containers on an on-going basis, when 20-foot container availability is constrained, during mobilization for example, they are an acceptable substitute.

Recommedation: Change DoD policy to allow the use of 40-foot containers on an as-needed basis.

Utilizing 40-foot containers will expand the pool of containers available for munitions transportation during a mobilization surge.

3. Conclusion: There is no DoD program to ensure access to motor carrier equipment in time of war.

The DoD desires assured access to truck equipment in time of war but has not developed a partnership with munitions motor carriers during peacetime that indicates commitment to future availability. Issues that affect equipment availability include lack of backhaul shipments, limited operating hours at ammunition installations, and DoD's policy of obtaining lowest-cost transportation services. Under these conditions, new entrants into the munitions carriers market are unlikely; many of the current carriers may leave the market if conditions do not improve. The DoD must establish a long-term program with existing munitions carriers to encourage doing business with DoD.

Recommendation: Develop a long-term incentive program for munitions motor carriers.

Existing programs such as the Civil Reserve Air Fleet (CRAF) and Voluntary Intermodal Sealift Agreement (VISA) guarantee access to transportation assets in the time of war. A similar program could be established for CONUS ammunition transportation.

4. Conclusion: Infrastructure and throughput improvements have been directly related to rail and containerization.

All infrastructure improvements made since Desert Shield/Desert Storm have been in the area of containerization and rail throughput. The planning assumption is that containerized ammunition will be transported by rail. Evidence, DoD has purchased 321 89-foot flatcars and 5,000 CADS containers. However, there has not been any investment in motor carrier infrastructure or capacity improvement. Motor carrier capacity will not be there when needed for mobilization if it is not maintained during peacetime. If, in time of war, the rail capacity is nonexistent, there needs to be a backup plan.

Recommendation: Department of Defense should enter into long-term contractual agreements with qualified munitions motor carrier companies to insure the necessary transportation capacity exists in wartime.

C. RECOMMENDATIONS FOR FURTHER STUDY

1. What would the affect of delays in the railroad network be on railcar availability during mobilization?
2. Given that the commercial sector emphasizes intermodal movements, what is the feasibility of utilizing existing intermodal networks for ammunition transportation?
3. What long-term contractual agreements with motor carriers would ensure throughput availability for DoD needs?
4. Should DoD purchase truck container chassis and prestage them at ammunition depots, similar to CADS containers, to alleviate truck equipment shortages during surge conditions?

MOTOR

CATEGORY I	CATEGORY II	CATEGORY III and IV
TL:	TL:	TL:
1. SM and DN (w/NAC)	1. SM and DN (w/NAC).	1. SM and DD
2. Exclusive use of vehicle.	2. Exclusive use of vehicle.	2. Locked and sealed by shipper.
3. Locked and sealed by shipper.	3. Locked and sealed by shipper.	3. Trip lease not authorized.
4. Single line-haul required.	4. Single line-haul required.	4. Single line-haul required.
5. Trip lease not authorized.	5. Trip lease not authorized.	
6. When two or more vehicles are in convoy, drivers must be in sight of other vehicles at all times.		
LTL:	LTL:	LTL:
1. SM and DN (w/NAC)	1. SM and DD.	1. SM and DD.
2. CONEX, dromedary, or similar container authorized.	2. CONEX, dromedary, or similar container authorized.	2. CONEX, dromedary, or similar container authorized.
3. Locked and sealed by shipper.	3. Cargo packaged to a weight of at least 200 lbs. and banded, or container locked and sealed by shipper.	3. Cargo packaged to a weight of at least 200 lbs. and banded, or container locked and sealed by shipper.
4. Single line-haul required.	4. Single line-haul required.	4. Single line-haul preferred.
5. Trip lease not authorized.	5. Trip lease not authorized.	5. Trip lease not authorized.
6. Exclusive use of vehicle or authorized container.	6. Exclusive use of vehicle or authorized container.	

RAIL (CARLOAD)

1. RG	1. RI	1. RI
2. MTX	2. MTX	2. MTX
3. Locked and sealed by shipper.	3. Locked and sealed by shipper.	3. Locked and sealed by shipper.
4. Immediate notification of consignee of delivery.	4. Immediate notification of consignee of delivery.	4. Immediate notification of consignee of delivery.
5. Use appropriate Category I motor security for any associated motor movement.	5. Use appropriate Category II motor security for any associated motor movement.	5. Use appropriate Category III or IV motor security for any associated motor movement.
6. Use load divider doors when available.	6. Use load divider doors when available.	6. Use load divider doors when available.

COFC

1. In rail phase, same as category I rail; In motor phase, same as category I motor, authorized RG.	1. In rail phase, same as category II rail; In motor phase, same as category II motor, authorized RI.	1. In rail phase, same as category III and IV rail; In motor phase, same as category III and IV motor.
2. Use only approved shipping containers and place on railcar door-to-door to prevent unauthorized access.	2. Use only approved shipping containers and place on railcar door-to-door to prevent unauthorized access.	2. Use only approved shipping containers and place on railcar door-to-door to prevent unauthorized access.

APPENDIX B. TRANSPORTATION ASSET REQUIREMENT CALCULATIONS

The following data and calculations clarify the transportation asset requirements for peacetime and mobilization. Table B.1 presents total per month motor carrier munitions shipments from the eight Tier I and II ammunition depots to the three DoD ammunition ports.

Table B.1. Depot Shipment Summary.

Date	Anniston	Bluegrass	Crane	Hawthorne	Letterkenny	McAlester	Red River	Tooele	Total	Yearly Total
Jan-95	3	0	8	7	0	6	0	0	24	
Feb-95	3	0	29	2	12	2	1	1	50	
Mar-95	7	4	45	11	2	27	17	0	113	
Apr-95	9	4	13	22	5	5	13	4	75	
May-95	11	14	46	16	79	28	4	1	199	
Jun-95	17	7	40	42	8	21	4	4	143	
Jul-95	9	88	87	26	3	7	3	12	235	
Aug-95	1	2	7	8	12	1	8	8	47	
Sep-95	46	2	15	32	12	36	17	5	165	
Oct-95	6	7	33	9	4	10	1	3	73	
Nov-95	18	24	66	9	5	56	35	3	216	
Dec-95	7	2	4	2	2	2	4	9	32	1372
Jan-96	0	2	2	35	2	2	1	1	45	
Feb-96	4	13	32	12	3	68	13	1	146	
Mar-96	0	0	38	7	15	19	0	9	88	
Apr-96	4	4	33	24	3	24	2	6	100	
May-96	4	7	15	36	18	21	4	5	110	
Jun-96	0	0	3	9	1	18	7	0	38	
Jul-96	20	2	10	14	14	10	26	14	110	
Aug-96	38	1	9	6	2	24	10	9	99	
Sep-96	18	10	31	6	10	31	2	3	111	
Oct-96	9	11	42	20	8	36	13	5	144	
Nov-96	13	8	31	6	1	2	0	3	64	
Dec-96	33	1	65	15	0	4	3	3	124	1179
Jan-97	4	18	36	60	16	107	23	18	282	
Feb-97	6	6	21	9	11	61	0	1	115	
Mar-97	1	2	29	11	2	25	3	4	77	
Apr-97	15	41	21	23	38	26	21	10	195	
May-97	9	10	28	10	3	16	14	4	94	
Jun-97	2	0	27	23	1	15	2	16	86	
Jul-97	2	9	64	31	16	13	34	0	169	
Aug-97	23	33	37	14	15	18	2	3	145	
Sep-97	16	2	46	28	33	31	40	12	208	
Oct-97	15	8	25	1	1	33	8	0	91	
Nov-97	2	34	37	1	7	34	41	1	157	
Dec-97	6	4	76	14	12	24	30	8	174	1793
Jan-98	6	2	45	21	16	58	7	5	160	
Feb-98	7	0	2	2	11	4	2	0	28	
Mar-98	20	22	81	38	8	10	0	4	183	
Apr-98	9	7	96	15	20	30	6	9	192	
May-98	2	0	45	6	1	12	0	9	75	
Jun-98	57	1	27	7	3	20	1	3	119	757
Totals	482	412	1447	690	435	997	422	216	5101	5101

The following Table contains total amounts of DoD ammunition shipped per year by mode and weight.

Table B.2. DoD Peacetime Shipments By Mode and Weight.

	Truck			Rail				% of Total	
Year	Truck (pounds)	TEU	Trucks	Rail (pounds)	TEU	Railcars	Total Weight per Year	Truck	Rail
1992	859,669,520	30,923	19,104	332,727,487	11969	3327	1,192,397,007	72%	28%
1993	703,503,780	25,306	15,633	175,973,000	6330	1760	879,476,780	80%	20%
1994	557,525,520	20,055	12,389	122,280,000	4399	1223	679,805,520	82%	18%
1995									
1996									
1997	571,627,244	20,562	12,703	283,902,690	10,212	2839	855,529,934	67%	33%
1998	563,509,663	20,270	12,522	170,866,850	6,146	1709	734,376,513	77%	23%
Aver.	673,081,516			228,720,794			901,802,310	**76%**	**24%**

Data was obtained from Government Bill of Lading information contained in the CONUS Freight Management (CFM) program. 1995 and 1996 data were considered unreliable as a result of a major system changeover at Defense Finance and Accounting System (DFAS) [Ref. 28].

Twenty-foot Equivalent Unit (TEU) computations assume, per MTMC's Operations and Plans Office, that 13.9 Short Tons is the weight limit for 20-foot containers [Ref. 22]. Computations to determine the required number of trucks assume, per Industrial Operations Command, that each truck carries 45,000 pounds [Ref. 29]. Computations to determine the required number of boxcars assume that each car carries 100,000 pounds [Ref. 29]. Percentage of total for each transportation mode was determined by dividing the weight shipped by truck or rail during a particular year by the total weight shipped during that year. Examples of each computation from 1992 are:

--859,669,520 pounds/27,800 pounds/TEU = 30,923 TEU
--859,669,520 pounds/45,000 pounds/truck = 19,104 trucks
--332,727,487 pounds/100,000 pounds/railcar = 3,327 railcars
--332,727,487 pounds shipped by rail/1,192,397,007 total pounds x 100 = 28%

The average percentage of total by mode was applied to the trucking shipment data from the ammunition depots to the ports to determine an approximate number of rail shipments for a given year. For example, in 1995 there were 1372 ammunition shipments by truck with 45,000 pounds per truck, which equals 61,740,000 pounds shipped by truck. On average, 76 percent of the total weight shipped for any year is shipped by truck, so 61,740,000 pounds/.76 = 81,236,842 pounds total. Of that total, 24 percent of the shipments were made by rail, so 81,236,842 pounds x .24 = 19,496,842 pounds shipped by rail with 100,000 pounds per railcar equals 195 rail shipments.

The following Table represents the amount of ammunition required for a MRC, as set in the MRS BURU. It is assumed that a ton equals 2,000 pounds. The numbers of trucks, railcars, and TEU are based on the entire amount of ammunition being shipped by that mode.

Table B.3. MRS BURU Requirements by Weight.

Truck (pounds)	TEU*	Number of Trucks	Rail (pounds)	TEU	Number of Railcars
1,848,000,000	66,475	41,067	1,848,000,000	66,475	18,480

Table B.4 represents the number of TEU, trucks, and railcar equivalent units based on the DoD goals of maximum containerization and 90 percent of total shipped by rail and 10 percent shipped by truck. Railcar platform numbers are based on the intermodal transportation planning standard of one 40 foot or two 20-foot containers per platform [Ref. 22].

Table B.4. DoD requirements using 90% rail and 10% truck.

10% Truck	TEU	Trucks	90% Rail	TEU	Railcar Platforms
184,800,000	6,647	**4,107**	1,663,200,000	59,827	**29,914**

Table B.5 represents the transportation assets required to transport the MRS BURU ammunition weight requirement using the current modal ratio of 76 percent truck and 24 percent rail.

Table B.5. DoD requirements using 24% rail and 76% truck.

76% Truck	TEU	Trucks	24% Rail	TEU	Railcar Platforms
1,404,480,000	50,521	**31,211**	443,520,000	15,954	**7,977**

APPENDIX C. TRUCKING COMPANY QUESTIONNAIRE

1. How long have you been in business?

2. How long have you been shipping arms, ammunition and explosives for the Department of Defense?

3. What was your revenue for 1998?

4. What percentage of your overall revenue was Department of Defense arms, ammunition or explosives related?

5. What percentage of your overall shipments were Department of Defense arms, ammunition or explosives?

6. Do you participate in intermodal shipments of Department of Defense arms, ammunition or explosives?

7. If yes, with whom and what network?

8. At this moment, how many DTTS tractors are in use shipping Department of Defense arms, ammunition, or explosives, and how many are available for use?

9. How much arms, ammunition, or explosives or how many trucks in what period of time are you contracted to provide during a deployment for a contingency or MRC?

10. When transporting sensitive arms, ammunition, and explosives, do you follow the same routes from identical origins and destinations or do you vary them?

11. How many DTTS equipped tractors do you have? What is your total fleet size? How many of your total are satellite transceiver equipped?

12. What percentage of your shipments of arms, ammunition, and explosives are Truck-Load (TL), Less-Than-Truckload (LTL) or dromedary?

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